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August 17, 1959

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	H15 3	Kaylock H15 (H15) Tensile Strength: 150,000 PSI Material: AISI 304
	H16 3	Kaylock H16 (H16) Tensile Strength: 150,000 PSI Material: AISI 304
	H17 3	Kaylock H17 (H17) Tensile Strength: 150,000 PSI Material: AISI 304
	H18 3	Kaylock H18 (H18) Tensile Strength: 150,000 PSI Material: AISI 304
	H19 3	Kaylock H19 (H19) Tensile Strength: 150,000 PSI Material: AISI 304
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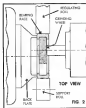
Figure 1 illustrates the results of a loose fit between a roller and the guiding rib of the raceway. Because of lack of guidance by the rib, the roller is free to slide and tilt under load. Such a condition invariably leads to early bearing failure.

To achieve close roller fit and proper roller guidance, Bower practices green grinding bearing ribs on specially designed centerless grinders. In this operation, Bower positions the integral raceway ribs from the *steerhead* centerline of the bearing. This method produces bearings with high dimensional accuracy and perfect symmetry.



Fig. 1. Loose fit in raceway causes poor roller guidance. Roller can slide and tilt under load.

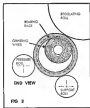
In addition, the close tolerance held in grinding the roller track and integral guiding ribs gives Bower cylindrical roller bearings the ability to ride straight in any direction. A Bower cylindrical roller bearing has three capacity of



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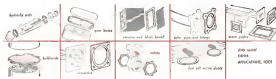
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Newest techniques. Many advances in magnesium casting have been reached at this Dow foundry. In fact, Bar City has been permanently assigned to development work, keeping the foundry in the forefront of technological advances at all times.

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THIS SAND CAST GEAR was built to fit 300 in. diameter housing. Before casting, the gear was precision ground to fit and after the casting process was complete, the gear was precision ground to fit.



These three are the three different types of magnesium castings that Dow can produce. For more information, contact: Mr. Robert H. Hiett, Dow Chemical Company, Bar City, Michigan 49810. (313) 338-1000.

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EDITORIAL

Defense Trends

The passage by Congress of the Fiscal 1960 Defense Department appropriations bill provides some interesting clues to the trend of the defense business over the next three to five years of present policies continue.

Signaling of the Fiscal 1960 appropriations bill into law by President Eisenhower will launch off a series of announcements from the Pentagon canceling and cutting back major weapon development and procurement programs. As is usual in such cases, the official excuse will be that these limited programs are "marginal" and that it is "economic and necessary" to concentrate there in view of the new super weapons that are just around the corner and development corner.

In fact, the military usefulness of these weapons will have little to do with these actions. They are dictated solely by budget considerations that are getting tighter and tighter each year while both the Congress and executive branch of the government fail to face up to the genuine problems of providing a technologically modern and relatively superior defense program.

A further indication that the future with a constant level defense budget in the face of rapidly expanding problems is the key to our defense program is found in Defense Secretary McNamara's frank admission that the Fiscal 1960 budget will require a 10% across-the-board cut in all weapons development and production programs. This 10% across-the-board cut for Fiscal 1960 piled on top of the major cuts already required by the Fiscal 1959 budget cannot help but result in a greatly reduced defense capability in the critical decade of the 1960s.

The dilemma in which the Pentagon now finds itself with a continuously decreasing defense capability (this is what the slogan of a constant level defense budget really means) in the face of a continuously increasing challenge from the Soviet Union is a result of the failure of military and civilian defense leaders, the Congress and the President to really tackle and solve the complex technical, fiscal, and organizational problems involved in having a truly effective modern defense capability.

These facts, like with the military, have led to a constantly piling up individual service welfare above the overall considerations of an effective national defense.

The inability of military leaders to make decisions and settle vital matters of military policy within the frame work of the Joint Chiefs of Staff has resulted in the imposition of a superstructure of civilian "experts".

These "experts" were given the job of making the decisions the military dodged and, in so doing, the obsolete, blind, and an intricate of the defense organization. This superstructure of civilian bureaucracy erected on top of the military politicians has also aided greatly in making any effective progress. It has simply added another tangled web of red tape to Pentagon processes. And by its failure to make decisions, it has opened the door for the bookkeepers of the Budget Bureau to make vital military decisions based solely on fiscal considerations. The further this parallel production program, the Nike-Bomarcet, now so which McNamara finally admitted the Pentagon could make no decisions and invited Congress

to "hold our feet to the fire," provides specific examples of how is a lack of military decision wastes money with out providing any real increase in defense capability.

In view of this situation, which has grown steadily worse during the past five years, it is small wonder that Congress has been driven into the vacuum created by the Pentagon's inaction and is now attempting to plug the hole originally cut for the Joint Chiefs of Staff and the Secretary of Defense. We can hardly blame Congress for attempting to bring some order out of the defense chaos. But its efforts during the current session indicate clearly the haphazard and contradictory decisions that emerge from this activity.

The Nike-Bomarcet controversy provided the ultimate shambles when a House group recommended cancellation of the Bomarcet and expansion of the Nike program, while a Senate group studying the same problem broadened the Nike system "infinitely elastic" and recommended expansion of the Bomarcet program. Clearly not much progress will result from this type of activity.

The result of this drifting, indecisive trend where only the Budget Bureau bookkeeper will make decisions has sharpened inter-service rivalry to an intensity almost beyond reason, has left the top level confusion in the Defense Department unchanged as a welter of confusion and miscommunication, and has turned most of the decisions of Congress into military "experts" second guessing the Joint Chiefs of Staff. All of this means that we are getting precious little in genuine defense capability from the close to \$40 billion we are pouring annually into the Pentagon's hopper.

The pitifully small forces we were able to move to meet the twin crises in Lebanon and Formosa last year provide a measure of this sad situation. While depletion of the military budget have cited these efforts as proof of our effective defense capability, it is interesting to note that they have not discouraged the Communists from attempting similar efforts, including the break free now being in Laos.

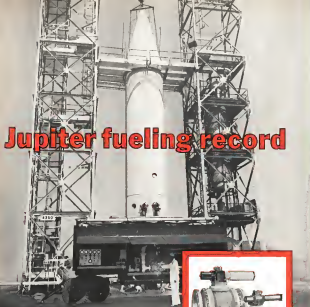
More money is certainly not the sole answer to our future defense problems. We need to make more effective use of the billions already provided before making claims can be made for more.

What we need even more is development of a technically and politically modern defense strategy and a defense organization that effectively integrates all elements of the three services into this strategy rather than attempting to equip each service to do the military job by itself.

We also need a program to intensify inform the American public on the requirements of such a defense program in place of the unopposed ball game now emanating from the top level of the Pentagon in a futile effort to ramshackle over the expanding cracks in our defense structure.

We also need a determination that extends from the grass roots of our 50 states up into the White House and Congress that we are and will do whatever is necessary to preserve this country as a beacon of hope shining out over the dark sea of Communist oppression.

—Robert Hiett



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WHO'S WHERE

In the Front Office

As Com. F. R. Kania, a director of The Ballou Group, Ltd., Bough, Yorkshire, England and of two of the companies with the group (Blackburn Aerosol Ltd. and Blackburn Engines, Ltd.)

William G. Boush, a director, Ames, Tex., Woodville, N. Y. Mr. Boush is now in new president and general manager.

Forrest K. Lutz, a director, Dulles, Va., St. Charles, Mo.

Robert N. Koss, a director, Stanford, Calif., Los Angeles, Calif. Mr. Koss continues as vice president marketing.

James K. Cory, a director, Control Data Corp., Minneapolis, Minn., and director of engineering of the Computer Division. Electrical equipment and installation.

Robert W. Koss, a director, Stanford, Calif., Los Angeles, Calif. Mr. Koss continues as vice president and chief financial officer.

Don S. Stephenson, president, Canadian Pratt & Whitney Aircraft Co., Ltd., Montreal, Canada, according to Ronald T. Bates, director.

William L. Rodick, president, Corbin to Diamond Film Corp., Nevada, Del., a subsidiary of The Field Co.

Robert P. Goss, president, U. S. S. Corp., a subsidiary of Yopp Industries, Inc., Los Angeles, Calif.

Robert V. McLaughlin, president and a director, Armco Inland Wire Co., Inc., Torrington, N. Y.

Robert L. Goffick, vice president, Delta Air Lines, Inc.

Andrew C. Biele, vice president engineering, Walburn Precision Instrument Co., O'Fallon, Ill.

Dr. Henry Mankins, vice president and manager engineering department, Koss Scientific Corp., Mountain View, Calif., subsidiary of Koss Manufacturing Co.

R. D. Verma, a vice president, Texas Instruments, Inc., and division manager of the Microelectronics Division, Dallas, Texas.

Regina S. Goshel, vice president and manager engineering department, Ames, Tex., Woodville, N. Y.

Philip R. Farnum, vice president, The New York Air Brake Co., Air Brake Division, New York, N. Y.

Charles R. Halliwell, vice president operations, Fordon Air Lines, Inc., and chief, Sales & Service, New York, N. Y.

John L. Chaffin, vice president and manager engineering, Capt. Paul L. Foster, assistant vice president flight operations.

Charles A. Clavel, vice president and manager aircraft sales, The Ballou Co., Phoenix, Ariz.

Edward W. Hoffer, Chief, International Field Service Division Office of International Coordination, United Nations Agency, Washington, D. C.

(Continued on p. 118)

INDUSTRY OBSERVER

► Project Transit, pressure space program for which Navy has been given the go-ahead by Defense Department that far, concerns placing a navigation satellite system into orbit by 1964-65. Boosters for the project will be provided by the Navy as all-the-dull team.

► Initial evaluation tests on Tactical Air Command's "portable avionics SAGE" air defense system will begin in the near future at Shaw AFB, S. C., using five radar sites located at air bases in North and South Carolina and in Georgia. The system, identified as 225A, includes three types of search radars: short-range low-altitude and the AN/SPS-23 three-dimensional surveillance radar using an elevated antenna; the third, a two-dimensional AN/SPS-25 extremely long range set. Last two are produced by Westinghouse Electric. Tactical air control computers are supplied by Stratton Road. General Electric is responsible for system integration plus design of data processing and display subsystem.

► Army recently met with four companies competing for its Marder field air defense missile program to learn of any new ideas that had been developed since the original proposals were submitted in December. The offers proposed ground defense, a new expected to be made into the next several weeks. Bidders include a Convair-Rathbone team, General Electric, Martin and Sperry Gyroscopic Co.

► Navy, if it can find the money, is considering retrofitting the Douglas A4D attack bomber with the 7,500-lb thrust Pratt & Whitney J52 engine. Navy officials say installation of the J52 is a replacement for the present 7,000-lb thrust Wright J65 should provide substantial improvements in performance and reliability.

► Navy also may adopt the 5,000-9,000-lb thrust Pratt & Whitney JTF-10A-1 jet engine developed for Douglas' DC-9 transport jet transport for use in the Crusader A1F "slow" plane designed to maintain a speed of Mach 9 at sea level. Original program called for use of the J52 turbojet in the jet-engine A1F. Under recent planning, first production version of the JTF-10A-1 are not scheduled before the summer of 1962.

► More than 100 of the nation's top civilian and military scientists completed a 10-day symposium last week on ballistic missile defense problems and possible solutions. Classified symposium was sponsored by Advanced Research Projects Agency.

► Last of the currently proposed Nike Hercules anti-aircraft missile installations for the continental U. S. is scheduled to be in operation by mid-1960 according to present timetables.

► Navy hopes to see the first sea-launched Polaris fleet ballistic missile from the USS Compass Island within the next four to six weeks.

► National Science Engineering Co., Pasadena, Calif., is conducting advanced analytical studies relating to the dynamic response of Navy's Polaris fleet ballistic missile system under subcontract to Lockheed's Missile and Space Division.

► North American Aviation and Boeing Airplane Co. are performing laser altimetry analyses for Air Force under Study Requirement 385, with contracts of approximately \$100,000 each.

► All Douglas Nike Ajax and Hercules anti-aircraft missile units scheduled for use by the Italian air force will lose the primary mission of defending the Corfu missile site of U. S. Army's Southern European Task Force in southern Italy (AW July 26, p. 31).

► Douglas Aircraft officials say the Nike Zeus system will have an anti-satellite capability in addition to its principal design function of destroying ballistic missiles.

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Washington Roundup

Radical ARDC Shuffle

Radical reorganization plans to regroup all Air Research and Development Command activities under four divisions—Ballistic Missile and Space, Aeronautical Systems, Electronic Control and Command and Research—was scheduled to be presented last week to Lt. Gen. Bennett A. Schriever, ARDC commander, for his approval. Under the plan, ARDC is said to establish a central headquarters for all of its electronic activities as the division aims to detect and coordinate efforts of Cambridge Research Center's Electronics Directorate, the Rome Air Development Center, and most of the major equipment laboratories at Wright Air Development Center. Headquarters for Aeronautical Systems Division, responsible for manned aircraft and related weapons, would be located at Wright-Patterson AFB in Dayton. Ballistic Missile and Space Division headquarters, probably would be located at Edwards AFB, although Holloman AFB is a contender. Research Division headquarters, probably would be located in Washington. Weapons Systems and Electronic Support System Project Offices, now in Dayton, would function as part of the appropriate divisions and they probably would move to Boston.

If approved, the plan, prepared by an ARDC group headed by Col. J. C. Adams, is expected to result in transfer of some systems personnel from WADC and RADAC to the new Boston division headquarters.

No Rush for ANP Changes

Apparently there is no hurry at top Defense Department levels to find a new management approach for the Avrami Nuclear Propulsion program. Defense Secretary Neil McElroy has said there are some considerations of new approaches about, but that no proposal has reached him yet. As for a change in new management personnel, he said, "Well, I'd say that this isn't something that I am pressing for. I really don't have a time to read."

ANP program director Maj. Gen. Donald Kern is retiring, and this has been suggested as a good time to review ANP management technique and make a fresh approach. An F-4 was approved by Gen. James C. Brown to replace Kern as his USAF job, but Brown was not named to take Kern's job as director of the Defense Department and Atomic Energy Commission ANP efforts (AW Aug. 18, p. 25).

Barnack Base Study

Department of Defense is making a detailed study of the possibilities of locating B-57 bombers in Canada. House Appropriations Committee voted construction funds with this understanding. The money for sites in the northeastern part of the U.S. between the Great Lakes region and the Pacific Coast won't be used until the study is completed and prospects for the Canadian sites explored.

The committee considered that Defense Department's "master plan" of armed Nike Hercules and Bomarc missiles for air defense "is a major step in the right direction," but it is "as near as the fact admits, it leaves much to be desired."

Defense Secretary, Neil McElroy, was in Canada last week discussing North American air defense matters with Canadian Defense Minister George Pearson. Discussions included the role of Bomarc as a major of particular inter-

est since Canada has decided to rely on the Boeing interceptors instead of plans of the cancelled Avro CF-105 Avro aircraft jet interceptor.

Mace Site Funds Deleted

In another move, the House last week took another action to discontinue Air Force from having any more nuclear surface-to-air missile. House members cut out \$6.4 million for Mace facilities in Europe from Fiscal 1960 construction funds, which are now pending action by the Senate. Earlier, the House cut Mace ground-based funds from the Fiscal 1960 Department of Defense budget. After a strong plea from Air Force, the Senate granted authority to transfer funds from other projects for Mace if the Secretary of Defense first notifies the House and Senate Appropriations Committee that it is "essential." The House agreed to this Senate proposal.

Khrushchev's Military Sight-Seeing

Soviet Premier Nikita Khrushchev will be first to inspect a wide variety of major military installations when he visits the U.S. next month, but it will be up to him to decide whether he wants to visit military bases. Khrushchev is expected to make no more military installations to avoid going too far afield, but both President Eisenhower and Defense Secretary, Neil McElroy, think the Soviet premier ought to get a first-hand picture of the strength and competence of the U.S. military machine. Eisenhower said last week that Khrushchev will have a fairly wide choice in the character of installations open to him, and McElroy has suggested that Air Force Missile Test Center at Cape Canaveral and a Strategic Air Command base are the types of installations he might see.

McElroy's press conference statement that Khrushchev might be permitted to installations seen by the press but not open to the American public outraged Assistant Secretary of Defense for Public Affairs Martin. So did a report on a clarification. McElroy said that he "feels that when I said that we would like to make [Khrushchev] things which the average American citizen is not allowed to see, he thinks that I should follow that with a statement that we would not violate any law in doing so, and the things that our people in the press have seen are things which the average citizen is not allowed to see, but that there are no laws to make it illegal for him to see. In the way we intend this privilege, to you. . . I am not really sure who that is required, but I abide by my country's laws."

Petty Resigns

George R. Petty, Jr., resigned unexpectedly last week as president of the Flight Engineers International Association. The IAFA executive vice president Ronald Brown took over until the summer as Petty said at a union election scheduled for this spring. Petty resigned for "personal reasons," according to an IAFA spokesman. The union, however, preceded a planned meeting between IAFA and the AFL-CIO to discuss the engineers' connection with the Teamsters union. While Petty has accepted of from the Teamsters, Petty has been opposed to any membership move to affiliate with the union headed by James Hoffa.

—Washington staff

Air Force, Navy Face Procurement Cuts

Tight Fiscal 1961 budget ceilings force reviews of weapon programs; boron fuels are early casualties.

Washington—Sharp cuts in Air Force and Navy procurement programs are now being pushed through as a result of an Administration decision to hold Fiscal 1961 defense spending at present levels plus the quelling cost of advanced weapons systems.

Some cuts already have been ordered, others will be made within the next 60 days as the Fiscal 1968 budgets of the two services become available. The Army also probably will feel the cut to some degree, but the overall effect will be relatively light.

Directed an increase in Fiscal 1961 spending above the approximately \$40 billion defense budget authorized for Fiscal 1960, both Air Force and Navy are now conducting a project to project needs of a weapon system in their mission. Increasing program already approved for Fiscal 1960 in an effort to make additional funds available for new research.

Air Force already has ordered a halt to the development of the high range fuels and the General Electric P45 chemical engine planned for the North American B-70 Mach 3 bomber and cut the fiscal 1968 procurement program for Convair's B-58 Mach 2 bomber from 48 to 72. Overall the Air Force has trimmed its plans for the B-58 from five wings to three with each wing having a total of 36 aircraft instead of the 45 originally announced.

Other tentative steps planned by the San Diego include:

- Financing in fiscal 1986: present program for the Boeing B-52H intercontinental bomber from the "0" deferred to 60
- Diverting development funds planned for a new civil training and control aircraft to other channels
- Sharp cutback in buying program for the McDonnell Quail electronic reconnaissance aircraft planned for the B-37

Specific Navy cuts are now being fleshed out in the Office of the Chief of Naval Operations with the final decisions scheduled to be made by the end of the month.

The cathedrals in both Air Force and Navy, however, will go much deeper than procuring numbers from authors and prominent programs. One Pentagon spokesman said last week that "we're all slanted horizontally as we're now run. Now that we're going to have to be vertical cuts, we're just going to have to have fewer programs." (For another view on cathedrals, see p. 26.)

Defense Secretary Neil McElwain, in announcing the Administration decision to hold Fiscal 1991 spending to the 1990 level, said the decision was

under introduction to "major" disciplines, like certain social programs, or two weeks course.

He added that "just as last year when we came up in the making of a budget, you told us that you are going to lay off one or two months and solve the kind of problem we are up against. We are up against the prohibition of programs, and if that one is equal, they probably are going to have to drop out."

Melkers also stated that, "I think we poets, we have got to find a way to keep our role of speaking from advancing." He added, however, that he saw little chance that "we can really achieve our purpose."

Leicht Casualties

High runway barrier aircraft fuels, the latest example of tightened defense spending, have been dropped back into the development laboratories in last week's Air Force and Navy cancellation of modernization plans.

Construction of the human fuel program followed quickly, upon the AEC's decision to drop development of the General Electric 9015 jet engine. Designed to burn conventional jet fuel, probably JP-6 in the turbojet section, the 9015 was to use the higher energy boost fuel in the afterburner, primarily to extend operating range.

In total, these civilian fuel programs represent a government commitment of more than \$150 million. To date, the Air Force has spent \$56 million on the development of boron-derived fuels, \$45 million on the construction of a production plant at Madsen Co., N. Y.

NCAM-B7A Engine

Aerospac Council Corp. will be principal subcontractor to Douglas Aircraft Co. on development of the air-launched ballistic missile designated AG-54A/B.

Aerospace was given the contract for early research and development work on the solid-propellant engine (apogee motor) system after being approved by a USAF source selection board.

and \$16 million on the development of the PMS. The Navy has spent \$38 million on the construction of a production plant at Miraflores, Ocala, and 14 chemical facilities on bases had development, including a liver, urine plant.

While the Air Force declines to answer speculations about the future of both the J5 and B-70 programs, it will go on the future of advanced military research aircraft) in general, the J5 and B-70 along with North American's Mach 3 F-104 fighter are still active programs at present. New plans call for the B-70 to use the J55 engine which General Electric is developing in

parallel with the 1943 Designated primarily for the T-109, the 1943 and the Indication fields throughout, probably some of the worst and now, parental Indication fields are, and evaluation by Wright Air Development Center (AWAC) Aug. 10, p. 27).

Also, the basic compounds are not to be demanded completely and still as possible high quality. Each for future growth and profits. Original only for the conditions of production plans, specified that research and development efforts on the basic facts are to remain stable in addition to the Air Force and Navy National Aeronautics and Space Administration and Advanced Research Projects Agency are reported to be sponsoring research and development work on the boron field (including the effects on air, water, soil, to mention a few) boron has proved to be needed

The production stop order, which is believed to have originated with the Department of Defense rather than with an individual military officer, might cost Air Force, Navy and industrial groups involved in the program far more. All critical indications are that the decision was based primarily on economic considerations rather than technical ones.

As a lipid fuel, the human derivation offers a potential heat content of up to approximately 27,000 Btu. It compares with roughly 15,000 Btu for the

IP-2 and IP-6 type by dissection technique. It was discovered early, however, that more construction in a pit was required. The bottom-level hatch formed a basic crude dredge on further dissection, such as means and station, that virtually precluded their use in the harbor portion of the voyage. The dredge-dis was deposited on afternoon walk, again early, because its efficiency.

But scientists believed they could fix first the afterburner problems of the bombers. And last January President Eisenhower, in his report to Congress,



First photo shows Tartar on Pacific Coast. Model's record is 28.979. Tartar is listed in Division of Great Lakes.

new offspring had been tested which was found easily free of the bone problem than earlier was to put the liquid bones to scale production moved in on last May, the Air Research & Development Administration's Wright-Patterson AFB.



First Photo Shows Navy Tartar Launch

First photo shows Tarte's expensive outfit from a posh inside being launched from USS Norton Sound, a posh inside ship, off the Pacific Coast. Master's cardigan is similar to that of the strand ship of Navy's advanced version of the Coast Guard (AM) [10] 20, 70. Tarte is about 10 ft. long and about 1 ft. in diameter. Shells, produced by Navy Bureau of Ordnance by General (Gordon) Division of General Dynamics Corp., will be primarily submersible weapons on destroyers. Armored General dual thrust submersible rockets launch both thrust down launch also. Launchers, located forward, launch missiles outboard the vessel until it reaches the target.

what was expected to take place in the near future.

- **Defense Department** overrode a contract for a study of the entire base's fuel situation to Arthur D. Little, Inc. in May, not already receiving the \$1.5 million contract. The study was cancelled.
- **Responsible USAF** and West coast fuel Congress that if fuel couldn't be contracted with General Electric for the next 10 years, 1974-1983, it would be leaving this prime vendor that it had dropped its plans to process the former Soviet (Soviet) high energy fuel at its own expense, and that it would be left with which not to be accepted by the Office of Management and Enterprise.
- **The Army** made both moves apparently without consulting the Air Force and the Defense Department. Defense has had study has been finished as of May 1974.
- **Defence Department** has been told by Arthur D. Little spokesman that the study was cancelled.
- **Defence Department** has been told that the cancellation of the Navy's plans to produce home fuel at its own expense is a \$55 million plan in Washington, D.C.

new afterburner had been designed and tested which was found to be "appreciably finer of the house design problem than earlier versions." Plans to put the liquid boost fuels into large-scale production moved ahead. As late as last May, the Air Materiel Command's Aeronautical Systems Center at Wright-Patterson AFB was studying the matter of expanding the production facilities then under construction, as light of the large demand anticipated for the boost-based fuels in 1965.

Suddenness of Competition

The usefulness of the cancellations order might be the Accounting System Center all paid Approvals, how what could be learned USAI headquarters did not consult with either Air Materiel Command or Air Research and Development Command prior to making its cancellations decision and announcement. As a result, actual shutdown plans and procedures are still in a state of flux.

At the end of last week, however, there is what had already happened and

Paddlewheel Satellite Probes Radiation

Washington—National Aeronautics and Space Administration's Explorer VI satellite, the most complex experimental payload launched by the U. S., is making a variety of measurements over a broad spectrum of space conditions as it follows its highly elliptical orbit around the earth.

Launched from Cape Canaveral by an Air Force Thor Able III vehicle, the satellite is using a new digital telemetry system to report measurements from an instrumentation complex which is using solar energy as a primary power source.

Since the first solar cell energy pre-roads from the satellite to check solar energy receivable problem, the vehicle as

a whole has been labeled the Paddlewheel satellite by NASA.

Paddlewheel satellite, the new design Explorer VI by NASA after it went into orbit, acquiring the designation from the radiation satellite which failed to get into orbit when its June 11 launch vehicle was destroyed shortly after liftoff (AV Aug. 5, p. 61).

Radiation satellite payload will be launched again, probably next month. Explorer VI was launched 48 days to the north from the Air Force Missile Test Center and went into a high elliptical orbit with an apogee of 24,541 miles and a perigee of 137 miles, a pattern very close to the orbit sup-

ply intended. Orbital time is 12 hr 46 min., and velocity varies between 5,117 mph at apogee and 33,957 mph at perigee. Explorer VI weighs 91,140 lbs on each orbit count.

Launch Vehicle

The Able III launch vehicle was similar to previous Thor Able vehicles, using an Air Force Douglas Thor first stage and two modified Vanguard upper stages. Autopilot in the Aerojet General liquid rocket second stage has been strengthened and was lighter than previous models and guidance system could be controlled from the ground for the first time.

Eight spin rockets were fired in one and stage burned to stabilize the payload and the Allegory Ballistic Life-center and propellant third stage. Explorer VI is spinning at 160 rpm. The satellite has an Atlantic Research Corp solid rocket in it which could have been fired to provide 5 lb. of thrust to change the orbit if perigee had been too close to the earth, but this small failure model was not needed.

Explorer VI development and launch was an NASA project, with Air Force Ballistic Missile Division directly responsible for launching and receiving via facilities of the satellite. Space Technology Laboratories, Inc., provided systems engineering and technical direction. A Douglas Aircraft Co launch team conducted the launching. Thor Able III was the third Thor launch; 10 of them have been Thor Able vehicles.

Paddlewheel Structure

Paddlewheel satellite is a spherical with a slightly flattened bottom. It is 26 in. in diameter, 29 in. deep and weighs 142 lb., and its aluminum skin is 1/8 in. thick. The four solar cell paddles set from the satellite's vent on arms that were spring loaded to extend when the plastic nose during the launch vehicle was jettisoned just before third stage ignition.

Each of these paddles is about 20 in. square and each has 1,000 silicon solar cells on each surface. These 1,000 cells are divided by glass films which filter out harmful ultraviolet rays which saturate, appropriate light except. Hoffman Electronics produced the solar converters in modules of 100 cells, 70 on each side. Each module produces about 4 watt of electricity under direct sunlight.

Solar cells charge the batteries which power the satellite system and are expected to last as long as the satellite—about a year. A voltage gauge measures solar cell output, and battery charging



TEST SOLAR paddle is fired to satellite (left) to determine fuel design. Tightly packed instruments in it right

rate can be changed by ground command if necessary. Complete power supply system, including batteries, weighs 30 lb. Solar cell element of the satellite system is considered an important test of a potential power source for long range space vehicles.

Telemetry backup is provided with duplicate transmission of most experimental data by the first transmitter in the satellite. Transmitters operating on 108.06 mc and 108.09 mc send timing information, and the primary transmitter sends digital data on an unduplicated UHF frequency. Primary transmitters power requirements of 10 watts in a two hour for the solar cells and batteries to support continuously, so the transmitter is being used on command

about one and a half hours out of every six.

Ground command is effected through a receiver on the satellite which can control 30 different functions, including broadcast code of the primary transmitter UHF frequency of the primary transmitter and command receiver is unduplicated in most possible satellite structures with the command function. Satellite also has a VLF receiver for radio wave propagation experiments.

Digital Telemetry System

New digital telemetry system developed by STL permits on-off use of the primary transmitter. Called Telemetry, this digital system stores and takes co-

ventional data while the transmitter is off, then transmits the processed information on command. Digital system supports a lighter load on the power supply than the usual analog system which must operate continuously, and the digital data is more easily processed on the ground.

Transponder on the satellite acts as a complex system to measure its velocity. This provides a check of a system which provides real-time information and which could be used for real-time guidance of satellites with more difficult mission than Explorer VI.

The highly elliptical orbit of Explorer VI permits a wide range of energy level measurements in the radiation



AIR FORCE Thor Able III launches heavily instrumented Explorer VI satellite.



ORBITAL PATH during first 36 hr. moved across Europe and Middle East within days of the earth. It then moved southwest toward Cape of Good Hope as satellite traveled farther away from earth and satellite caught up with Explorer's relative motion



EXPLORER VI is payload is prepared for installation on third stage of Thor Able launch vehicle. The 20 in. square frame holds down the payload less 1,000 lbs. coils on each side and are providing electrical power for operation of the satellite's instruments. Hole on top of the satellite is the mouth of the small antenna used to send signals if a bad loss has close to earth, a star is not used.

lights. These were measured by various carrier Explorer satellites and by Pioneer I and Pioneer III, but Explorer VI will provide more copious data over a greater period of time. During its year at the place of the satellite's orbit will sit toward the place of the equator and provide data on the radio from both where they are strongest.

Radiation counters in the satellite are measuring three energy levels. A device developed by the University of Chicago measures high energy particles. It consists of an air-filled cylinder surrounding a scintillation crystal and a lead-shielded detector will sense the gas and create an electrical impulse in this procedure the scintillation

Moskov energy sign is measured by a combination of two instruments provided by the University of Minnesota, an ionization chamber for total flux and a Geiger-Müller tube for count rate. STL scintillation counter is used to measure low energy radiation.

Density and pattern of ionization centers in the sun traveled by Explorer VI is measured by metal plates on opposite sides of the satellite's mast. Microphones pick up signals on the plates for ionization transmission.

Magnetic field of the earth is measured by magnetometers developed by STL. Searchwind magnetometer gauges the magnetic field and its direction and a fluxgate magnetometer is used with it to measure the spin axis component of the field. STL also has developed a plane computer which measures the phase relationship between the output of a spin magnet and the search coil

magnetometers, providing the "H" direction of the magnetic field.

A magnetic coil similar to a tele-voice counter was developed by STL for the Explorer VI payload. It senses the earth on each revolution and provides data each orbit, in turn, from less than one day to a complete picture. Transmitted picture will have a resolution of about five miles and can provide a wide picture of the earth's cloud cover.

Radar wave propagation experiments are conducted with Explorer VI to determine effect of the ionosphere. In one experiment, signals at 13.5 Mc from Navy radio station NBS at Arlington, Va., are received by the VLF receiver provided for the satellite by Stanford University, and the results are transmitted to ground stations. In another, signals from one of the Navy's VLF transmitters may be received

by two earth-based receivers spaced on a 475 statute mile line to measure amplitude and phase fluctuations induced by the ionosphere. Ground equipment for this experiment is in place at the National Bureau of Standards Laboratory in Boulder, Colo.

Signals from UHF and VHF transmitters will be used at the Kilauea, Hawaii station in a comparison of doppler shifts. Comparing doppler shifts of the two transmitters will provide data on the relative effect of electrons density in the ionosphere on signals with these two frequencies. VHF signal also will be used by the Hawaii station to measure the Faraday rotation caused by variation in electron density between the satellite and the ground station.

Internal temperature of the satellite is recorded by surface resistance of the skin. Readings are teletransmitted on ground temperature and temperature of the solar cells. An experimental device for controlling temperature inside the satellite has been tested successfully. A heat-absorbing black patch on the surface with a one mil hole in it. When this patch is used in a certain hole, the cell expands and activates the pyroelectric switch to cover the black patch. When the covered patch melts, the cell retracts the pyroelectric array, exposing the patch and allowing temperature to rise again.

Explorer VI is linked by a number of U. S. points, but principal command and data reception points are at Jodrell Bank, Manchester, England; Kilauea, Hawaii; Mather, Md., N. H., Sacramento, Calif., and Cape Canaveral. These points are connected by a telephone circuit with the control point at STL's Space Navigation Center in Los Angeles. Experimental data will be transmitted to the control point by radio. The radio control, provided by STL, is used to STL for complete processing.

Multiple antennas have been installed on antenna at Jodrell Bank and Kilauea to permit reception and transmission of signals on a single antenna at the same time.



THOR ABLE third stage (longer) is solid propellant, second stage magnetometer testing.

New Navy Radar Holds Promise Of Long-Range Missile Detection

By Philip J. Klein

Washington—New type radar which shows promise for detecting the faintest of ballistic missile nuclear engines and nuclear explosions at intercontinental distances has been reported by the Office of Naval Research.

The ionosphere back scatter radar that can detect long volumes of sound gas produced by hot nuclear engine exhaust as a nuclear explosion operates in the high frequency band (1 to 10 mc) normally used for long-range radio communications.

High frequency radio signals propagate over long distances because they bounce off the ionosphere, reflect back to earth, then back to the ionosphere and back again to the earth, skipping around the globe in this fashion. At each contact with the ionosphere or the earth a small fraction of the radio energy also is reflected backward toward its source.

It is the back-scattered energy, or echo, that is exploited by the new radar. The radar transmits in short bursts or pulses, producing a non-transmitting period in which to receive the back-scattered echo.

Each reflection off the ionosphere and off the earth produces a weak echo each displaced in time from the preceding one. When the signal energy strikes a large volume of ionized gas, such as that produced by a nuclear launch or nuclear explosion, it produces an echo with a distinctive shape, pattern which can be distinguished from ordinary ionospheric back scatter echoes.

The new radar concept, conceived by Dr. William J. Doolittle of the Office of Naval Research, was developed under the code name of Project "Jupiter" (a T-1) directed from "Thales Radar." Other groups participating in the program include the Nuclear Products Engineering Division of AEC Industries, National Bureau of Standards Lincoln Laboratory and the Naval Air Test Center.

The radar's advantages and limitations both stem from the fact that it operates in the high frequency band. Unlike most conventional radars which operate at higher frequencies, the new back scatter equipment is not limited to short line-of-sight ranges. Intercontinental ranges can be achieved with moderately low power when compared with that required by more conventional ballistic missile detection radars.

One of the more serious limitations is the fact that sun spots and solar flares severely affect the ionosphere's propagation characteristics, causing

complete blackouts in high frequency radio communications. Presently, the new radar would be even more vulnerable than most conventional radar systems. Furthermore, a small or clear explosion in the upper atmosphere of the Project Jupiter type also could block off H-F propagation for an extended period.

The new radar also may be vulnerable to electronic countermeasures. By plotting a low-power H-F transmitter in the vicinity of the track, launching etc., an enemy could generate signals that could block the radar's radio return signal without any other effect.

One high frequency back scatter radar has been used to determine the direction and approximate distance of a nuclear explosion or rocket launch, but unknown in the propagation path made it impossible to determine. It was necessary to determine the direction of the launch by other means, such as triangulation. The target location could be established more precisely.

The new radar appears to find application in an early warning device to supplement other techniques, such as the Ballistic Missile Early Warning

System and Project Mako infrared sensing satellites.

The technique does not now appear suitable, however, for tracking ballistic missiles by continuous observation for some time. ICBM satellites using the H-F signals do not penetrate the ionosphere, because they do not follow the missile after launch.

Doolittle says that "promising" results have been obtained over long ranges using breadboard equipment. "We are confident that a system capable of reliable detection over intercontinental ranges is feasible," Doolittle says, "but we do claim for the radar's ability to track a ballistic missile. The same technique has detected a nuclear explosion 'three miles off radar axis' according to the Defense Department."

The idea of using the high frequency band for long-range radar is not new. More than 50 years ago, Air Force's Remote Air Development Center sponsored development of an experimental H-F radar. Project Mako indicated that the radar had H-F search for an aircraft, although the length of interest at that time. However, the equipment did find use as a means of determining what direction an aircraft was moving, or its relative time of day for reliable communication with a distant station (AW Aug. 17, 1953, p. 127).

Recent months has taken a fresh look at H-F radar for ICBM detection and is currently conducting an in-house investigation.

Semiconductor Advance Detailed

Pennings, Pa.—"Transmuted vacuum tubes" which require no heater or filament power may result from a recent discovery that certain semiconductor materials can be made to emit electrons, according to Westinghouse Electric Corp.

Westinghouse reports that two of its research physicists have discovered that a thin, thin cathode coated with a certain semiconductor will emit electrons when a voltage is applied across a built-in junction. Current devices operate with emission from the cathode of a small vacuum tube type tube.

The use of a thin semiconductor instead of a cathode in vacuum tubes could solve the heater and cathode of a conventional vacuum tube could, Westinghouse says, give tubes a new lease on life in their battle with conventional limitations by eliminating the need for heater power and the consequent problem of dissipating heat.

The scientists now are exploring by Westinghouse dials from those used in "cold-cathode" tubes developed by General Electric and other firms in the Tung Sol Electric Co. The former requires a strong electric field to draw electrons from a point source type cathode. The Tung

Sol approach requires application of a higher voltage to start electron emission from a magnesian oxide coated cathode. Delay in the flow of electrons after application of the trigger voltage is one drawback of the Tung Sol tube, which tends to limit use to lower frequencies.

Electron emission from electron cathode semiconductors, the discovery of visible light in the form of electron beam emission, Westinghouse reports, when the voltage applied across the semiconductor junction is sufficient to cause the breakdown of its internal electric resistance. The emitting spots measure only about 20 microns across, as well as diameter, with densities of about one microampere from each spot.

The first test electrons are emitted from only two spots, some suggest that the new discovery might also find application in cathode ray tubes to provide an extraneous thin electron beam without all of the complex focusing circuits now required.

Westinghouse says it is continuing its investigation of the new discovery in its research laboratories, as well as working on its application to specific devices.

Congressmen, Retired Officers Termed Sources of 'Pressure'

By Katherine Johnson

Washington—E. V. Haggren, former Assistant Secretary of the Air Force for Material and now executive vice president of Westinghouse Electric Corp., told members of the House Armed Services Subcommittee last week that Pentagon officials are "under pressure" on procurement matters from both congressmen and former high-ranking officers.

Testimony by Haggren, Assistant Air Force Secretary between 1951 and 1955, was in contrast with that given to the subcommittee by a number of retired officers—including Adm. Arthur Radford and Gen. Omar Bradley Jr., both former chairmen of the Joint Chiefs of Staff—during their last street entries this week who said in an audience of former officers in Pentagon in trying to influence procurement.

The main emphasis of Haggren's testimony, however, was on the role of military officials to educate. He told the subcommittee that former officers have not only technical knowledge but also a grasp toward economic, administrative, and pure business data.

Haggren reported that if he or someone else in the Air Force is put a particular job on the list of contractors who had employed high ranking officers to use influence on their behalf. He said the Air Force "strongly flag" to name the Air Force "trained people" to use that fact before the other side of the table had former Air Force connections." During his tenure as Assistant Air Force Secretary, Haggren said it was obvious that "vested interests" were being used too much. He said Pentagon officials "exerted" the pressure of both congressmen and retired officers.

When he heard that Westinghouse was back in the top position as a sub-system subcontractor on the North American B-79 Mach 3 bomber (AW May 13, p. 23), Haggren admitted that he promptly contacted Pentagon officials "to let them know our capability and to let them know our knowledge of our capability." Westinghouse subsequently received the subcontract. Haggren characterized that as a classic example of good science.

Other developments before the subcommittee, according to Haggren, of contractors influence in defense procurement included:

- Officials of Boeing Airplane Co. testified that they were forced to plan all requirements on the basis of its Boeing as a defense contractor built for the Air Force in Washington newspaper to prevent "misinformation" being introduced on behalf of the Army Douglas Nike Hercules air defense system.

- E. R. South, vice president of Western Electric Co., gave Mike Haskins, chairman, testified that a "bible" change. South said that it was "greatly concerned" that a Western Electric advertisement on behalf of Nike appeared in Washington newspaper in the last of an advertisement campaign on a "water plan" for its defense.

It also was developed at the hearings that Boeing officials had contacted the House Appropriations Committee. Western Electric officials told the Senate Appropriations Committee to create a new defense fiscal 1960 budget for the defense. Northrup company, considered the "strongest" influence, had simply a matter of keeping congressmen informed.

Raytheon Wins Platform Contract

Washington—Raytheon has received a \$90,000 to 1-year study contract from Wright Air Development Center for the company's proposed subcompact, unarmored helicopter which can be used as a flying platform for surveillance radar or extended range communications radar (AW May 13, p. 15).

Several companies have submitted proposals to Raytheon including Sikorsky and Vought.

The platform, which could hover at altitudes of 10,000 ft, would be powered by a two-engine, engine, mounted up to it from a ground radio transmitter. It could use a small gas turbine, powered by conventional fuel for initial lift-off and climb to altitude to drive, compressed air through jet jets in the rotor blades. Once on station, the vehicle would be sustained aloft by rotor wake, caught behind up to its exhaust.

Raytheon estimates that approximately 1,000 hp at the rotor would be required to sustain the vehicle and an additional motor, compressor, to provide 1,000 hp at the rotor, the one pump, estimates that approximately 20,000 hp (15,000 kw.) of electrical generating capacity would be required on the ground. Raytheon estimates that the efficiency of about 9.5%. The latter figure means a 65% efficiency for the ground power transmitting antenna,

Defense Secretary. Ned McElroy, in personal conversations concerning the little of advertisement in connection with the Boeing-Haskins situation, but strongly defended "to company's right to put before the American people its confidence as supplier of high-quality military products as an evidence of its importance as a good citizen of the U.S."

- J. D. Wright, president of Thompson Ramo Wooldridge, testified that he does not have a problem here, as most of those Technology Laboratories was the latter's role in technical advice to the Air Force to assist Thompson Ramo Wooldridge agreement to be completely divorced from the production operations of the company. As long as STL keeps operating in the black, he told the commission, he has no objection to it. But as a debt to our shareholders, we may have to become active in reorganization if it were to go into the red.

A new headquarters for STL is being built at Cannon Park in southern California. It is an outgrowth from the headquarters of the Ramo Wooldridge Division of TRW to further complex development of activities Wright reported. STL's headquarters are now three miles distant. TRW elects the directors of STL.

"15% pattern efficiency, 65% efficiency for the subcompact receiving in terms and 50% efficiency for the Air Force program."

Recent advances in technology for radar, Raytheon's Amphibious radar more power supplies told him special the due to the novel radar power of its platform. In the past year, the company has developed a radar system for 100 ft in range, but he said he had to persuade his customers.

Raytheon reports it is now producing Amphibious which can deliver 28 hp at 1,000 rpm, frequency and can that 100 hp units will be available within two years. With standard aerial radar of development Raytheon believes it can produce radar with outputs of 600 hp. Models in which the vehicle has large amounts of power at higher altitudes, frequency with surface phase stability to permit parallel operation of standard radar, radar it possible to transmit different power to various altitudes just as the same radar can be used for different things. It is a group of small antennas located in 400 sq ft would serve for the ground station. The 16 antennas would be used to compute the flying platform's location altitude into a circular orbit for those 100 ft in diameter. Helicopters would carry a light



LEADERSHIP IN USAF FIGHTER-INTERCEPTOR PROPULSION



J79: world's most-flowed Mach 2 engine

General Electric's J79 turbojet has demonstrated its reliability by logging more flight hours than any other Mach 2 engine in the world. Typical of the J79's record is its outstanding performance in the Lockheed F-104 Starfighter—world record holder for speed, altitude, and time-to-attack.

Operational flying with the USAF's Air Defense Command and Tactical Air Command demands the most of an aircraft and its engine. In the face of these requirements, the F-104 is establishing an outstanding record.

Endurance of the J79 engine's reliability grows more convincing daily. During 1959, USAF Starfighters have been making an unusually high rate of utilization rate, with a correspondingly low percentage of flight engine complaints.

Basic key reasons for the J79's outstanding operational record are the simplicity of its single rotor variable stator design, high resistance to foreign object damage, excellent throttle sensitivity, high altitude afterburner light-off characteristics, and ease of maintenance.

More than 90% of total U.S. Mach 2 flight time has been logged by General Electric J79's. Further evidence that it is today's top Mach 2 fighter propulsion powerplant. General Electric Co., Cincinnati 15, Ohio.

Progress Is Our Most Important Product

GENERAL  ELECTRIC



O'er the ramparts...

U. S. Army's

NIKE HERCULES...

Solid rocket motor built by Thiokol for Nike Zeus has produced greatest mass discharge rate and thrust of any single

Through the combined efforts of the U.S. Army, Western Electric, Douglas Aircraft, Thiokol Chemical and other key members of the missile industry, America is moving toward the realization of a critically needed anti-missile missile.

The Nike Zeus system — big brother to the Army's Nike Hercules, which now stands guard over major population centers — is being designed to detect, charge and destroy attacking ICBMs many miles from their targets.

Assigned development of the boost for the Zeus, Thiokol has already designed, built and successfully test-fired a motor achieving over

Thiokol
CHEMICAL CORPORATION
Bristol, Penna.

Nike Hercules

NIKE ZEUS

solid propellant motor ever test-fired in the free world... unleashes more than 400,000 lbs. of thrust in static firing!

400,000 pounds of thrust—power enough to deliver the instant reach of high altitudes needed for effective defense.

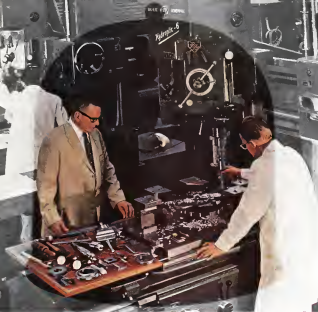
While the Zeus booster stands as the most powerful solid propellant motor now in record, it is no way represents the ultimate capability of present Thiokol facilities. Current capacity includes motors still larger—or ICBM and even satellite size.

Under Army direction and in cooperation with Douglas Aircraft, Thiokol, development in the Nike program has advanced the science of rocket propulsion.

DOUGLAS

The Nation's Partner in Defense

Nike Zeus



Left: An IGW's ball-joint ball-and-socket joint, right: IGW's precision-machined ball-and-socket joint. IGW is a division of the company.

Precision is our only product!

At Indiana Gear, precision goes far beyond the usual customer requirements. Precision is a part of order coordination, engineering, production, inspection... a part of every Indiana Gear operation. Precision is a way of thinking at Indiana Gear... a method of always working beyond the fringe of the state of the art.

IGW
INDIANA GEAR WORKS, INC.
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weight circles receiving antenna of about the same diameter.

Mazouze camp received by the vehicle's antenna would be moved by a variable to glass elements which would convert it into heat. Compressed air or gas heated by these elements would then drive the turbines which supply power to the rotor top-gens.

In addition to the fuel control for fuel, bleed-off and dump to station, the vehicle would carry a small reserve to take it over in the event it heads out of contact with the ground-based antenna radio base.

To hold down the weight of the vehicle's payload, Penhose proposes that the firing platform need be able to receive only the search antenna, deployer and a receiver instead of a complete antenna radar. The antenna signal would be generated on the

ground and transmitted to the search antenna, and the received radar signal would be relayed back to the ground. The Amphibious holes need to supply power for the search antenna to some form of insulation surrounding the radar platform to be superimposed on the power base, then extracted at the vehicle and sent to the search antenna.

A series of firing platforms could be used as a chain of microwave repeaters to provide secure communications in the Arctic or over the Atlantic, Caribbean and Indian Oceans. To use backscatter can be obtained which would provide more radio channels than now available in the entire high frequency band used for long-range communications and without the frequent outages due to ionospheric disturbances.

Unions Outline Industry Demands

Seventy-year bargaining program for 1990 was adopted by union representatives of aircraft, missile and related electronics workers at the International Association of Machinists and United Auto Workers joint conference in Kansas City, Mo.

The seven basic proposals, which will be presented at the next round of negotiations with major employers in the aerospace industry, are:

- "Wages—Actual cost-of-living wage increase to be sought as the next organization will be decided at a joint IAM-UAW "pilot" conference to be called later this year."

Unions stressed elimination of disparities in job classification and changes in job requirements to design as the cost of living.

- "Severance pay—Any employee who is laid off or terminated and who has one year or more of service should receive minimum pay proportionate to the length of service. In addition to protect the non-union portion of union or non-union allowance for which he or she is eligible. Severance pay shall be available to pay for each month of service.

- "Reduction pay—Any employee whose work site is transferred or moved from his initial place of employment shall be entitled to pay for travel time and transportation for the expense of transporting his family, or for sleeping and moving his home.

- "Union security—Attendance of union shop across the board in the aircraft and missile industry is a basic and serious objective for both unions."

- "Hospital, surgical and medical insurance—These should be established a sound and adequate basic benefit which will satisfy the medical and dental hospitals, surgical and medical requirements of the employees."

- "Life insurance—In those contracts where life insurance coverage does not at least equal average annual income, even effort should be made to achieve this objective."

- "Pensions—The following principles will be adopted in re-negotiating pension contracts: The plan shall be 100% employer financed, contribute funding of benefits will be provided on a vested basis, all aspects of the plan will be made fully portable. Provision should be made for voluntary retirement before age 65. Workers should be entitled to \$1,000 lump sum benefit on death after retirement. We should stress to protect the purchasing power of the pension by providing adjustment to design as the cost of living."

Third X-15 Delivered

Third North American X-15 rocket research aircraft is undergoing tests; maintenance check at National Aeronautics and Space Administration high speed stream at Edwards AFB.

The third X-15 will demonstrate contract compliance, the first two X-15s have and the atmosphere and power plant testing in the No. 1 vehicle will require less flight testing before beginning actual research program flights.

A total workshop of the Rocket Motor, \$6,000,000 cost, XLR-66-1 rocket engine, mounted in the third X-15, goes to installation of the actual engine. First flight of this aircraft has not yet been scheduled.

The second X-15 will come into the first general flight. The X-15B program will be substituted for the XLR-66-1, designed for the X-15 (AW Mar 30, p. 39).

News Digest

Air Force Considers AF4D
Initiated a test and, some cost about \$300,000, says the Atlantic Missile Range test work in the third successful test of recent had extra modifications. One more test shot is scheduled, but the success of the first three is expected to lead USAF to launch an AF4D within a few weeks from Vandenberg AFB to establish the initial operational capability, originally scheduled for July 1, and delayed since a succession of Atlas test failures (AW July 6, p. 27).

Boeing Airplane Co. has consolidated its Seattle and Everett Aircraft Division and its Everett Management Office into a single unit, Aero-Space Division with Boeing Vice President Jack A. Wood as general manager (AW April 27, p. 34).

Firefield Engine & Airplane Corp. reported a first half net profit of \$245,000, compared with a net loss last year of \$1,001,000. Companywide sales were \$60,599,000 this year and \$67,841,000 last year.

Consensus Aircraft Engineering Corp. reported first half earnings rose to \$5,326,000, or 84 cents a share, from \$2,182,000 or 47 cents a share last year as a \$73.6 million sales increase from \$107,332,082 to \$181,461,446.

Reus Amusement Co. will design and build a "New Air" jet fighter ball game which will enable the player to make "extremely short takeoffs and landings." Contract was awarded to Greenman.

Sperry Gyroscopic Co. is developing one of the high-power radio transmitters to be used for target tracking in the Army's Nike Zeus anti-aircraft missile defense system, says the company's Bell Telephone Laboratories.

Army officials this week will start evaluation of the Sikorsky S-60B (see story under a contract) citing the several weeks of evaluation at Ft. Belvoir, Ala., Ft. Belvoir, Ga., and Ft. Belvoir, S.C.

Gen. Maurice G. Deane, chief of staff of Japan's Air Self Defense Force, and a train of six officers will be in the United States for a two-month inspection tour to see the Greenhouse F117H, Lockheed F-117A, Northrop N-155F and General F102 and F-105.

Falwell Aircraft Manufacturing Director E. W. Farnham and Assistant Managing Director E. N. Egan will be leaving the company after its acquisition by Helmer Holdings (AW Aug. 3, p. 32).

Bilaterals Strengthen Foreign Carriers

BOAC, Air France gain round-the-world routes to meet competition from U. S. jet operations.

By Robert H. Cook

Washington—Foreign airlines are moving aggressively to meet the competition that posed by the introduction of jet operations over the global routes of U. S. flag airlines by securing expanded third rights under the bilateral agreements their governments have with the U. S.

While those approval last week of a Tokyo stop for British Overseas Airways Corp. was the latest indication of what U. S. carriers fear may be a trend toward wholesale demands for foreign airlines to give access to this country.

BOAC's efforts, followed on the heels of a new bilateral agreement in granting French traffic rights (AW Aug. 14 p. 36). Together, these moves would mean that for the first time, round the world services to compete with U. S. carriers at a time when foreign transporters are just making such global service truly practical.

BOAC will take immediate advantage of its new authority by starting a global service Aug. 31 with two B747-100s carrying flights a week between London and Hong Kong via New York, San Francisco, Honolulu and Tokyo. These flights will connect with the airline's current 4-day service between London and Tokyo through the Middle East to complete the global service.

Air France will start similarly services on its new global Paris and Los Angeles route after its Boeing 707-320 transporters are delivered, and the French carrier plans to establish round the world service in 1969 when Transavia's Aerosul-Touristik begins flying its Douglas DC-8s into Los Angeles over its route from the North Pacific.

State Department Stands

Department of State officials, who say that a complex, comprehensive of the bilateral route would result in a loss of Fifth Freedom traffic rights for U. S. carriers flying beyond France, view the new French bilateral as a compromise. During the U. S. State Dept. said that France gave up its demands for "double track" routes, or duplication of every route served by U. S. carriers. The post also fails to give the French the much desired right-of-way in the West Coast from New York.

While Air France has granted rates to the U. S. West Coast with a polar routing, an Air France spokesman con-

plained the equal importance of its losses of French routes from Tokyo to the West Coast via Honolulu. The Pacific route permits Transavia Airways' intercontinental, a Paris-Tokyo service, to be extended via Tokyo, and provide the French with round the world service.

South Pacific Route

This South Pacific route is considered significant in view of French plans to divert Tokyo to a transit center in competition with Japan. As 12,000 ft service at Tokyo will be available, for instant service in early 1969 when TAI and Air France can establish their joint global service.

Air France will make a stop at Montreal when it begins operating the Paris-

Los Angeles route with Boeing 707-320s. Meanwhile, Pan American World Airways plans to introduce foreign access over its Los Angeles-Tokyo route by Aug. 31. This route also is served by Trans World Airlines and Scandinavian Airlines System, and BOAC and Lufthansa also have rights to fly it.

BOAC Reaction

A BOAC spokesman said the airline is "delighted to have approval at last" of its Tokyo stop but turned the four month delay aside, saying: "While BOAC approval 'formally' encompasses this."

BOAC estimated that the delay cost it \$7.8 million in lost revenues. As airline spokesmen said, "navigated" service over the route means a Tokyo stop would not have been begun last March if BOAC had received U. S. approval anything more than a formality. In addition to revenue losses, BOAC had to incur additional fuel, baggage costs, and the Tokyo-San Francisco route.

The carrier also was forced to hold ship crews and their families idle at Honolulu throughout the course of negotiations between the two countries in a suspension of a pending decision in the case.

As approved by the Civil Aeronautics Board, BOAC was authorized to provide three types of work on the new route, but U. S. airline carriers deem authorization by the Japanese government the British carrier to indicate its schedule pattern or the route to a basic world route.

Japan Air Lines spokesman on the case has no plan to increase its own north flights in this country as a result of the BOAC route. However, the carrier is negotiating for the loss of a Boeing 707-320 from Continental Airlines to meet competition from Pan American and BOAC (see p. 47). Pan American on Sept. 1 plans to inaugurate weekly jet services between Los Angeles and Tokyo via San Francisco and Honolulu.

Northwest Airlines, which fought the BOAC proposal, also has no plan to change its scheduling as a result of the solution of Tokyo to the British route.

However, the carrier is not convinced that the threat of direct competition with the British airline is great. While BOAC will fly a mid-Pacific route to Tokyo as opposed to Northwest's route to Tokyo, the latter's policy is to fly the



707-423 Will Enter BOAC Service

First Boeing 707-423 international freight transport to the 510-707 to be produced at Renton, Wash., by Boeing's Transport Division. The model will enter British Overseas Airways Corp. service.

age, company officers claim that in Air Transport Agreement between the U. S. and Britain contains a clause allowing BOAC to use Anchorage as a landing stop. This, they say, makes possible direct BOAC flights between Tokyo and San Francisco. Terms of the Bermuda Agreement, under which the route was opened, also allow BOAC to drop its intermediate stops, such as Honolulu and Wake Island, making a Pacific route more practical, according to Northwest.

Other U. S. airline spokesmen believe that the British carrier will do a significant amount of traffic from both U. S. domestic and international routes. More than 90% of the traffic potential BOAC may realize is fifth freedom traffic accounted for by American branches in Japan. Tokyo, the spokesman point out, represents 90% of the total transpacific air traffic and adding the city, along with New York and San Francisco, to the BOAC route gives the carrier three major traffic gateways and is very much U. S. carrier.

Their fears were relaxed by CAB member Louis F. Hatcher, who said that, although the Board discussed the public interest aspect of the BOAC request, the outcome of the case was actually predetermined by the U. S. government's obligation to honor bilateral agreements.

Routing CAB Executive Director D. Norman's members of the BOAC request, Hatcher said that although he was concerned as granting the request he "guaranteed much of the BOAC's success in doing so. In practice he contended that, while the CAB conducts preliminary hearings on such matters under Section 402 of the Federal Aviation Act, such hearings are advisory since the government already is bound to honor the route terms of its bilateral agreement.

Delta Proposes Low Coast-to-Coast Fare

Washington—Delta Air Lines has proposed a reduced fare "throughfare" service on a coast-to-coast schedule in one of its major plans for improved service at the carrier is granted West Coast routes in the Southern Transcontinental Service Case.

Turning at Civil Aeronautics Board hearings last week, the airline said its plan also will offer five daily through schedules linking Atlanta and Miami with the West Coast and ten daily all-ages flights between those points with proton engine planes.

The airline has requested an extension of its present route system beyond Dallas-Fort Worth, Houston, Los Angeles, San Diego and San Francisco. Delta also proposes to link New Orleans, Atlanta, Caracas and other cities on its Caribbean routes with the California routes through a link up at New Orleans.

Delta said the Board that it plans to offer 231 million third class passenger miles in 1968 and expects a profit potential of \$1.50 per plane mile on the proposed service. Using DC-8s, in a combination of 67 fifth-class and 18 first class seats, maximum passenger revenue per plane mile is expected to be \$1.85.

Proposed throughfare fares would be about 3.87 cents per passenger mile, compared to current fares of 6.1 cents for first class and 5 cents for tourist service, the carrier said.

Based on an average trip length of 245 mi., Delta calculates the cost of the selected fare would be about \$2.15 per plane mile, and benefits per mile factor would be \$1.69.

Cargo flights planned by Delta would use DC-6s on an initial schedule of two daily flights connecting Miami and Atlanta with San Francisco and Los Angeles, with additional scheduled slots added as long haul traffic increased.

Braniff, Continental Report Profit Gains

Washington—Molson earnings reports of trunk airlines continue to register heavy gains, with Braniff Airways net income increased 187% over the first six months of last year, and Continental Airlines operating revenues exceeding a gain of 45% in the same period.

Braniff realized a net income of \$1,800,000 over the first six months of 1958, based on operating revenues of \$30,751,793 and total expenses of \$28,951,793 and total expenses of \$28,951,793 and total expenses of \$28,951,793.

In the same period of 1958, the carrier earned a net profit of \$873,660 on operating revenues of \$31,215,508 and expenses of \$31,444,844. Depreciation and amortization costs during the 1958 period were \$2,789,972, compared to \$3,401,435 for the first six months of last year.

Continental had a net income of \$109,008 during the period, compared to a net loss of \$335,600 for the first half of 1958. Operating revenues increased to \$17,466,906, compared to \$16,315,008 during the first half of last year, while expenses advanced from \$17,377,008 to \$16,954,800 in the same period. Much of the rise in interest and other expenses this year was attributed to a net capital gains after taxes of \$1,028,000 from the sale of assets.

First *electra/JET* service along the Pacific Coast



LATEST in a 30-year series of air travel "firsts" is Western Airlines' new *electra/JET* service. Fastest and most comfortable flying ever between **Seattle-Tacoma, Portland, San Francisco, and Los Angeles!** The revolutionary *electra/JET* is **big, powerful, jet-fast**—and its combination of jets and propellers has some wonderful advantages over ordinary jets. The ability to take off and land more quickly...faster climbing to cruise altitude...greater nimbleness on the ground to cut taxi and loading time. As a result, the *electra/JET* is one jet whose gate-to-gate timetable really tells the truth! Now, more than ever, Western's the wonderful way to fly!



"First in the West with *electra/JETS*"

**WESTERN
AIRLINES**

Japan to Lease 707 for Pacific Jet Race

By Glenn Gamboa

New York—Japan Air Lines is negotiating with Continental Airlines for the lease of one Boeing 707-120 jet transport to enter the Pacific jet competition. American Airlines has learned if the deal goes through as expected, the Japanese carrier could come close to matching the Sept. 5 transpacific air speed derby Pan American World Airways has set for its Boeing 707-120 aircraft.

Continental last week received its fourth jet, the final unit in its initial firm order. But the airline had optioned a fifth 707-120, and this airplane is off the production line and now is packed at Boeing's Renton, Wash., plant. It is fitted with a Continental interior and is an executive configuration.

Japan Air Lines has ordered four Douglas DC-8s for jet transports, the first of which is scheduled for May, 1960, delivery, and service with the airplane is expected to begin some time before July, 1960. (AW July 13, p. 18) But in the meantime, when the airline would give a considerable lead on the far more conservative Pan American expects to begin with two San Francisco-Honolulu-Tokyo and two Los Angeles Honolulu-Tokyo flights a week and this schedule will extend through the winter season.

Northwest Great Airlines has ordered five DC-8s for 1960 delivery and hopes to start service early next year. British Overseas Airways Corp. has announced plans to start transpacific vehicles next Sunday with its Britannia 112 helicopter transports, which will connect at Tokyo with BOAC Comet 4 jets to provide a round-the-world before-passenger service.

Continental Crews

AMERICAN WHEN learned that what one of Continental's crews is scheduled to fly to Tokyo that Japanese crew members will be teamed to at least partially replace the Continental personnel after the service gets under way. [AL now reports the previously projected transpacific service partly with U.S. pilots. (AW July 20, p. 18) and some U.S. fleet pilots probably will be used on initial DC-8 runs.]

The Japanese airline now flies nine weekly round trips between the U.S. and Tokyo, most of them with Douglas DC-7C equipment and the rest with DC-6Bs. It serves the three Pacific Coast gateways of San Francisco, Los Angeles and Seattle.

Service with the Continental 707-120 will undoubtedly begin at Los An-

gles or San Francisco, and possibly, after shifts between the two cities, with a final stop at Honolulu en route to Tokyo. The lease with Continental probably will extend past the start of DC-8 service. Such an arrangement would add to JAL's jet capacity while its DC-8s were being phased in and would provide additional crew training opportunities. It appears likely from geographic considerations that all-Japanese crews will be flying the 707 in some or practically.

Previous Leases

If the JAL-Continental deal is consummated, it will mark the third instance of an airline, transpacific, with one jet, leaving aircraft to meet or beat its competitors. First was National Airlines' deal with Pan American, giving National the use of 707-120s for its highly competitive New York-Miami run and Northeast Airlines records assigned to lease TWA jets for the same route next month. (AW June 29, p. 31)

Continental's four delivered jets will be able to handle its needs for the near medium future, according to its as-

sign. Since start of jet service June 8 between Los Angeles and Chicago, Continental has carried almost 10,000 passengers on the aircraft. It has been flying three, making round trips daily between the two cities, and was scheduled last week to add two more schedules, one with a stop at Denver and the other with a stop at Kansas City. On Sept. 5, the airline plans to add a second Chicago-Chicago-Los Angeles schedule for a total of six round trips daily between the two airports.

Continental has been averaging 111 1/2 hr. of daily utilization with its two jets in scheduled service. The fourth airplane will take over flight training duties, providing an extra first of three. The airline also is jet passengers, using Continental's new night jet flying routes. (AW June 25, p. 16), are averaging 45 sec. through the checker line at Chicago. Largest clearance, according to the carrier, took 2 min.

By Sept. 5, Continental will be operating more than 80% of its daily schedule with turbine-powered equipment including the Boeing jet and 15 Vickers Viscount helicopters.



Boeing Tests Fifth Pod on Qantas Jet

Qantas, Equipe Airways Boeing 707-120 jet transport, carrying its spare Pratt & Whitney PT4C engine during under its left wing in a fifth pod, took off on a test flight from Boeing Field, Seattle, Wash. Boeing pilots said engine pod, after not making short flights during previous flights. (AW July 18, p. 37) Boeing's "City of Canberra" display is shown on record at Honolulu, Hawaii, August. Boeing then would jet service between Sydney, Australia, and San Francisco, Calif. (AW July 20, p. 18) for 7,850 mi. route.



Senate Approves \$25 Million For MATS Jet Transport Fleet

Washington—Senate has today passed a supplemental appropriations bill to begin a comprehensive modernization program of Air Force Military Air Transport Service.

Previously, both House and Senate had turned down Air Force's request for \$13 million for 10 cargo jets for MATS in voting the Fiscal 1960 appropriations for Department of Defense (AW Aug. 10, p. 26). Air Transport Service has fought the project, claiming MATS would use the jets in cooperation with commercial operations. However, USAF and its supporters on Capitol Hill apparently decided on another attempt after final passage of the defense bill.

The \$20 million was approved after a brief presentation by a Senate Appropriations Subcommittee considering supplemental appropriations by Sen. Howard Cannon (D-Nev.). Cannon introduced his presentation with a letter from Air Force Secretary James H. Douglas supporting the measure.

An amendment by Cannon, the first step in the MATS modernization:

• First, "a high speed short haul" which would consist of one or three squadrons of Boeing 707, DC-8, or Comac 600 aircraft in a military configuration for efficient cargo handling. Appropriately \$13 million of the \$20 million would be available for these cargo jets.

• Second, a larger, faster, long-range "worldwide" aircraft for cargo handling and troop transport. It would replace the pentagonous C-124, of which MATS now has 140. Cannon said the replacement would "very possibly be something like the C-130." The additional \$5 million in the \$20 million bill is earmarked for the development of an advanced concept for the new worldwide aircraft.

• Third, completion of the program for the Douglas C-119 transport cargo aircraft now in the inventory. The proposed buildup to 58 is scheduled to be completed in three years.

An ATA spokesman suggested that Air Force "digged up" the \$5 million for the worldwide cargo aircraft to gain support for the jet cargo aspect of its MATS modernization program. He pointed out the support of Sen. Mike Mansfield (D-Mt.) Mansfield has been pressing for the development of such a plane for use, as well as for new jet services which include the Dallas-Los Angeles flight daily, Boston-San Francisco service via Chicago, daily Chicago-Dallas round trip, and a second daily Baltimore-Los Angeles round trip.

In May, Assistant Secretary of Defense Perkins McGary informed Mansfield that Defense was working with the Federal Aviation Agency on the development of a commercial-military cargo contract.

Last week, after the Senate voted funds for USAF to underwrite the development, Federal Aviation Agency Administrator Elwood Quesada concluded a substantial trading on FAA's program for development of an economic commercial cargo plane.

At the subcommittee hearing, Mansfield opposed placing control of the development with USAF "3 years control, from the record that we have laid in the past, that the Secretary of the Air Force, and none of his people, have ever been successful in developing or procuring a common type of cargo aircraft for the military or as a business operation per se—indeed it is the opposite of that," Mansfield said. "It is not the important element for the military, because they are seeking performance, and in business performance, they automatically get a lot of lighter, added equipment, lighter hardware, and things of that kind."

Cannon reported that USAF has "several proposals" for the commercial-military cargo aircraft.

American Claims Revenue-Miles Peak

New York—American Airlines flew 578,154,000 revenue passenger miles last month, a total the airline said was an all-time monthly high for non-military carriers. The figure was about 20% higher than the Feb. 1958 total, and, for the first time in American's postwar experience, the July total topped the June total. June monthly is the airline's highest traffic month.

Other recent news reported in air freight, an 10% over job of last year, for mail, up 15%, and surface mail, up 11%. American said its first four months, now totaling 15 Boeing 707-320 jets and Lockheed Electra turboprops, was largely responsible for the July record.

American last week announced new expansion of its turbine aircraft services. By Aug. 31, when the new aircraft is to be completed, plus call for new jet services which include the Dallas-Los Angeles flight daily, Boston-San Francisco service via Chicago, daily Chicago-Dallas round trip, and a second daily Baltimore-Los Angeles round trip.

New Effects services under the plan will include Chicago-Boston flight, a Detroit-Chicago-Dallas flight, a New York-Chicago-Dallas flight, a New York-Chicago-Dallas flight, and an increase to nine daily round trips in New York-Chicago service.

Slick Places Order For Three 1049Hs

Shick Aircraft has placed an order with Lockheed Aircraft Corp. for three 1049H Conquestor convertible cargo-passenger airplanes. Contract value is about \$7 million, including spares. The first airplane will be delivered immediately; the other two will be transferred to Shick next spring.

The move, according to Shick, is the first step in re-establishing the carrier as a U.S. domestic air freight customer carrier since its merger with Imperial Corporation (AW May 18, 1958, p. 31).

Purchase of the 1049Hs brings Shick's total order for Lockheed planes to nine within one month. The last placed an order with Lockheed's Georgia Division for an Super Hercules freighter with a contract value of about \$11 million (AW July 27, p. 51).

27 Airlines Bid For MATS Contracts

Washington—Twenty-seven commercial airlines have submitted bids to Military Air Transport Service for an 18 of passenger cargo contracts to Europe, Alaska and the Pacific area during the year starting Oct. 1.

Considered by MATS the largest single military airlift purchase ever made, the contract calls for aircraft from Sept. 1 until over 1960 for 138,600 passengers, 10,320 tons of cargo and 8,144 tons of mail traffic during the year. Commercial carriers will transport 139,600 passengers, 4,920 tons of cargo and 1,144 tons of mail cargo in the Pacific; 123,600 passengers and 5,800 tons of cargo across the Atlantic and 16,000 passengers in Alaska area.

Total of 37 airplanes, which is expected to be increased for the fifth year, the largest number ever to be placed on the military bidding list. Bid requirements were divided into 14 route segments.

BEA Signs Order for 24 Triple-Turboprop DH-121s

London—British European Airways Contract for 24 Airbus-built Lockheed DH-121 jet airplanes worth \$57 million was signed last week. The airline holds an option for an additional 24 aircraft.

A £10-million contract delay (AW Feb. 17, 1958, p. 41) was caused by specification changes reducing the size of the aircraft.



Airline profit-makers

The Boeing jetliners shown above are designed for profitable operations over all air line routes, from short routes to long very long-haul routes.

These outstanding carrying power has already been demonstrated by the 707. Since going into service last October, the Boeing jet has attracted unprecedented load factors of 90 to 97%. Operation demands it is the most popular aircraft in airline history.

Within weeks the 747 International—the world's largest-stage jetliner—will begin commercial operation. With a range of more than 3,000 miles with full passenger payload,

it will fly nonstop over the longest stages of airline routes, at cruise speeds above 600 miles an hour.

The 720 is the future carrier of its class, with a cruise speed of 544 miles an hour. Backed by Boeing's unexcelled flight experience, the 720 is an extremely versatile jetliner able to operate profitably over short routes and medium-range routes.

Boeing jetliners, now in scheduled service on United States and international routes, are demonstrating tremendous carrying power, extremely high initial reliability and unsurpassed public acceptance.

These airlines have already ordered Boeing jets

AMERICAN	AIR INDIAN	UNITED STATES
BOEING	RENTON	CONTINENTAL
COLUMBIA	BOEING	ALLEGHENY
PAN AMERICAN	QUANTICO	BAKING
SOUTHERN	AFRICANA	TWA
UNITED	SAFARI	ALU RAYS

BOEING
Family of jet airliners



BREAKER STRIP around AW 650 nose fairing done prevents strong underflow flow from causing turbulence on tail plane.

Argosy Modified to Cut Aft Turbulence

By John Tustall

London—With one third of the Armstrong Whitworth AW 650 turboprop freighter developed, completed, variable trouble-free designers expect full U.S. and British certification could come by next month. This is two months ahead of a schedule prepared nearly two and a half years ago when the project was started.

Using the first four production aircraft, the company has logged 538 flying hours since the maiden flight on January 21. Only three flights out of a total of 561 were cancelled for maintenance.

The only significant modification has been due to a flow breakdown along the upper portion of the fuselage, causing low frequency vibration in the rear fuselage and tail plane. The vibra-

tion was barely perceptible at first, but the vibration and the company was originally intended on need for correction.

Delaware Design Chief Engineer David Woodley told Armstrong Whitworth, modifications have been minor, and the behavior of the aircraft system which have been fully installed in all four aircraft has been good.

Cockpit Steps

Because of the top fuselage flow, the Woodley and in the relatively steep downward slope of the cockpit rear and to the high wing position. Also the fuselage is a twin boom configuration was particularly susceptible to vibration due to buffeting produced through lack of the damping effect of an integral wing.

Because of the broken top flow, the strong undisturbed pressure flow along the bottom of the fuselage is able to sweep around and under the tailplane and to the tail plane. The event is dependent on speed and appears to be in the 730 mph band.

Current attempts to improve the flow include vane generators on the lower edge of the cockpit blower and a breaker strip around the lower part of the fuselage and down which are placed up and flow from the bottom fuselage surface. The fifth aircraft currently is being fitted with a larger wing



TURBO HEIGHT loading flow speeds steps upstream (left); at right, polished length is moved to flow by locking piece.

After which may be able to reduce the breaker strip.

In the basic smoothness phase of the test program which has now been completed, all the stations have been cleared, and the aircraft has flown at maximum weights over its full range of gross weight. During the 12,000 lb aircraft is pointed up by its ability to hold 75 lb. with full flap, loading gear down and one engine feathered.

The company is now proceeding with the detailed evaluation of performance criteria.

Typical trials are due to start in September.

In the static test program, all the critical loading cases have been covered.

and fatigue testing now under way are a complete aircraft in the water tank has logged 5,000 lb. of sustained flight. Production is now an aircraft a month.

Following acceptance of a reinforced certificate of airworthiness to Mrs. Armstrong Whitworth has been using the fourth production aircraft for demonstration flights to airlines and for freight loading exercises. Fitted out as a mixed passenger freight variant with seating for 15 passengers, it will later be used for route-proving trials. Seats which fold flat against the sides and scissor-like bulkheads enhance the rapid convertibility of layout.

Company's performance target system is based on use of lightweight metal strips mounting small reflectors which are

belied to the freight door. Flaps can be stowed, retracted or tow type. Company studies Woodley claimed, proved that the added weight of the pitching equipment is easily justified by the flexibility and increased loading rates obtained.

Argosy sales test of the U.S. is scheduled for early 1960. Company now has expressions of interest for about 40 aircraft, but no signed contracts.

Reddy Airlines has ordered four AW 650s, with Rolls-Royce Dart engines (AW June 22, p. 112).

Company is negotiating with British Ministry of Supply for a military order of about 12 aircraft and continues future development of up to 110,000 lb gross weight.



TWO MEN can load polished freight in a short time, aided by roller strips on loading.



VORTEX generator (left) are installed on cockpit blower to help eliminate buffeting at times. At right is AW 650 cockpit layout.

The man:



A member of an Army Medical Corps air evacuation team. He belongs to one of the Army units which rush the sick and wounded to general hospitals by air. Past evacuation of casualties to hospitals has dramatically reduced the number of fatalities in "trench fever" or general warfare.

The mission:

In addition to its primary mission of supporting the strategic striking force, Military Air Transport Service also has the humanitarian mission of air evacuation—high-speed movement of wounded from base hospitals in the theatre of operations to the finest statewide medical care.



The means:

The Douglas "Jettmaster," proposed military version of the DC-8 Jetliner, with a cruising speed of almost 500 knots. It could wing 80,000 pounds of cargo, or 175 combat troops, or 152 litter patients with medical attendants between the U.S. and Central Europe in 7 hours!



Depend on

DOUGLAS



The Nation's Partner in Defense

Airline Traffic—June, 1959

	Revenue Passengers	Revenue Passenger Miles (RPM)	Load Factor, %	U. S. MAIL	Express	Freight	Parcel Post	% Revenue Available For Mail
DOMESTIC TRAFFIC								
American	759,349	240,359	80.8	1,714,529	144,376	6,523,047	40,177,283	16.8
Eastern	177,149	57,185	48.7	321,255	172,744	1,817,549	8,187,549	20.7
Continental	155,345	145,290	49.1	448,731	252,651	473,540	16,619,514	24.8
Northwest	150,861	80,481	44.2	126,467	30,876	147,445	6,120,323	24.7
Delta	142,514	122,450	59.7	346,694	215,433	1,251,717	14,472,152	22.9
Southwest	725,361	344,215	79.91	961,542	584,150	1,401,244	10,544,557	43.47
Western	126,929	10,977	36.2	233,229	40,937	331,231	3,364,176	44.2
Northwest	109,445	40,891	69.7	81,710	26,114	154,273	4,326,406	48.9
Western	176,512	157,345	44.2	519,872	253,894	1,241,514	15,305,544	24.9
Trans World	477,687	441,289	83.2	1,125,656	407,376	2,074,256	48,205,087	47.3
United	676,849	498,450	73.9	2,475,850	1,064,275	4,164,455	38,295,246	44.4
Western	114,937	77,414	49.4	371,745	10,344	364,143	6,157,094	35.1
INTERNATIONAL								
American	9,870	5,370	40.3	15,844	450	544,544	1,244,383	14.9
British	6,440	8,184	57.2	26,347	121,120	1,627,131	1,627,131	32.2
Continental-Airbus	26,344	5,491	49.9	7,245	4,450	345,663	449,449	44.9
Delta	4,335	6,691	30.3	6,277	33,545	715,411	715,411	48.4
Delta	38,420	29,344	59.46	73,933	154,273	554,273	554,273	74.46
Eastern	9,870	5,370	45.7	1,214	2,114	108,571	108,571	49.4
Northwest	4,922	6,244	34.6	4,714	4,714	241,104	241,104	30.2
Northwest	20,065	28,574	45.5	1,174,381	24,191	744,197	6,241,222	47.4
Pan American								
Airbus	2,714	6,322	44.2	42,707	191,106	895,191	895,191	44.8
Airbus	122,862	118,711	69.1	2,324,014	20,843	2,324,014	2,324,014	44.4
Latin America	115,819	150,545	71.9	311,729	4,154,450	47,179,403	47,179,403	48.9
Pacific	29,891	119,214	83.3	1,545,792	1,744,256	10,434,471	10,434,471	73.4
Panama	15,634	15,634	100.0	4,377,244	5,897,244	5,897,244	5,897,244	67.4
Southwest	30	31	19.4	1,174	4,344,161	4,344,161	4,344,161	77.2
Trans World	16,614	124,572	75.1	747,420	1,831,191	15,474,191	15,474,191	71.4
UNION	136	41	30.4	1,119	1,119	6,492	6,492	30.7
United	14,277	24,554	48.4	142,234	179,279	5,844,164	5,844,164	48.4
Western	4,244	6,677	48.4	12,840	10,197	750,198	750,198	48.4
LOCAL SERVICE								
Allegiance	55,868	8,848	59.7	11,550	31,494	37,719	1,895,489	22.3
Revenue	16,437	9,920	49.4	6,824	2,422	10,214	481,107	42.9
Continental	14,679	7,791	52.9	1,719	1,719	1,719	394,169	39.4
Frontier	26,344	6,241	44.1	31,339	10,161	21,144	757,101	37.7
Latin America	22,163	2,320	45.4	3,301	10,401	221,167	221,167	46.3
Northwest	10,816	10,816	100.0	6,314	12,244	1,161,244	1,161,244	47.3
Northwest	11,113	15,811	47.4	36,211	48,110	1,611,271	1,611,271	48.3
Southwest	11,213	1,090	44.7	15,816	22,816	24,144	757,164	46.9
Trans World	45,614	9,720	47.9	17,612	14,117	17,411	861,269	46.1
United	22,743	15,012	65.9	6,112	6,112	6,112	411,612	37.9
Trans World	24,379	6,761	46.9	17,619	7,321	34,709	611,614	46.9
West Coast	19,443	5,344	27.64	5,723	3,320	8,419	344,198	23.24
OVERSEAS								
Alfa	26,841	5,199	36.8	2,107	7,611	331,607	331,607	42.3
Northwest	45,720	16,811	36.8	5,522	124,161	1,461,578	1,461,578	73.1
CARGO INES								
AIRCO				4,363	6,427	2,777,021	2,800,340	73.73
American Sud American*	2,124	14,893	50.9	42,414	64,761	10,154,579	15,142,497	64.9
Delta				7,764	19,861	3,497,306	6,794,444	24.7
Revenue						473,411	473,411	64.9
Continental	3,791	21,260	61.16					61.16
HELICOPTER INES								
Chicago Helicopters	35,120	247	38.9	1,183			36,415	31.4
Los Angeles Helicopters	4,417	122.6	46.9	4,417	5,393		5,393	46.9
New York Helicopters	13,125	349	61.7	1,260	1,267	600	26,514	61.7
ALASKA INES								
Alaska Airlines	10,424	9,810	61.4	42,444	3,074	719,247	1,761,916	47.4
Alaska Central	6,477	548	57.1	8,470			75,136	37.9
Alaska Express								
Delta	6,148	243	61.9	2,444		3,714	42,444	61.9
Northwest	9,416	1,164	46.4	21,324		19,140	216,344	42.4
Pacific Northwest	14,243	1,423	61.2	119,214	5,067	3,444,361	3,444,361	71.2
Southwest	2,104	1,416	59.9	37,197		75,193	220,143	42.8
West Coast	5,561	1,822	37.9	36,700		371,764	457,344	42.9

*Not available.

Compiled by AIRCRAFT WEEK from airline reports to the Civil Aeronautics Board.



BEING TOWED to taxiway at N. Y. International Airport for engine runup, Turboprop Tu-114 shows stern cross-section in our view, masked negative shadow of its swept wings. Wings are as apparent when compared with personnel walking turboprop transport to taxiway.

Design Details of Aeroflot Tu-114 Turboprop



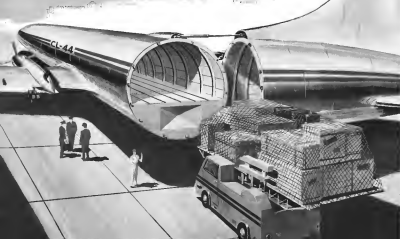
CLOSELY COMBINED Kuznetsov stainless-steel turboprop engine nacelle over 12,000 lbs. each, according to the Russians and one IFI type fuel and metallic lubricants (16% of 12.5% diameter reversible counterweight) propellers are closely forced into spinners. Propellers apparently have no blades, were a pair was altered being labeled together when a turbine spinning up suddenly.



LARGE inner engine nacelle duct houses large four-wheel main gear which is activated using two big electric motors in each wheel. Gear structure built inside an extension cycle according to Kuznetsov. Nose gear (left) is hydraulically actuated, as is two-wheel tail bumper. Russian engineers make up gear strictly from several components, build them together, rather than special base design single-piece unit. Also vertical movement between fork was added just above 10 ft. Close-up (right) shows main landing gear track, facing forward wheels, the tail of wheel axle. Close-up wing (left) shows left is located between oleo. Pacing step narrow gap between wing and lip (upper left). Exhausts meeting in and throughout Tu-114, rather than spreading in two-pointed band structure. Tail assembly (lower right) features reversible horn control stabilizer, nacelles indicating travel were on left side and gear ahead of stabilizer leading edge. Control nacelles use fixed with hydraulic boost system.



The Breakthrough Air Freighter that *smashed* the cost barrier!



CANADAIR JET-PROP CL-44

*...the first aircraft designed
specifically for the air cargo industry*

The jet-prop CL-44 was designed specifically to meet the immediate requirement for an aircraft that would significantly lower the cost of cargo movement.

In this highly important role, the Canadair CL-44 breaks through the transportation cost barrier and will revolutionize the whole air cargo market. It provides direct operating costs of less than 4¢ a ton mile and breakeven load factors as low as 28%, which are both lower than those of any other aircraft anywhere in the world.

The swing-tail CL-44 is already in production for the largest air cargo carriers in the world—Seaboard & Western Airlines Inc. and The Flying Tiger Line Inc.

- Payload—64,000 lbs. • Range—3,000 mi. • Speed—400 mph
- Engines—4 Rolls-Royce Type 12 • Cabin capacity—7,291 cu. ft.
- Floor loading—300 lbs. per sq. ft. • Passengers—up to 183
- Span—142 ft. • Length—138 ft. • Cabin length—98 ft.
- Gross weight—205,000 lbs. • F.A.A. takeoff field length—7,600 ft.

The Canadair CL-44 is also available as a passenger or as a convertible passenger/cargo aircraft.

**CANADAIR
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GENERAL DYNAMICS CORPORATION

AIRLINE OBSERVER

► **Watches For Iberia Air Lines** of Spain to announce the purchase of at least three jetliner aircraft within the next few weeks. Probable orders will be for Douglas DC-8s, although the company also has been looking at both Boeing and Convair jets. Order would be placed by the National Institute of Aeronautics, under the advice, and is reported awaiting the official backing of Spain's Council of Ministers. The aircraft would be used to cover expected jet competition from both European and South American operators and would be placed on Iberia routes to New York, Mexico City and the Caribbean.

► **Elmcor Airlines** has signed a credit agreement for \$1.25 million that will permit the airline to complete its re-equipment program with the purchase of four additional Convair 440 aircraft. The company, which now operates four Convair 440s, seven Douglas DC-3s and one Douglas DC-6C, plans to place out the DC-3s within the next two years. Terms of the agreement call for loans of \$750,000 each from the Bishop National Bank and the Bank of Hawaii, with the \$1.25 million balance to be provided by the First National City Bank of New York. Loans scheduled to be received by Dec. 31, 1965, and now obtained without a guarantee from the Civil Aeronautics Board.

► **Trans-Canada Air Lines** has completed installation of automatic weather radar on its fleet of 50 Vickers Viscounts and 15 Lockheed Super Constellation. Cost of its radar program, which began last September, is estimated by TCA at \$1.5 million, with Boeing and RCA radar units costing between \$14,000 and \$11,000 each. Maintenance and installation expense for each aircraft is about \$15,000.

► **Two trunk airlines** have introduced commuter ticket plans on an experimental basis and now expand the new service if it proves successful. Capital Airlines last week put its first commuter ticket books on sale, effective Aug. 2 over its Chicago-Minneapolis-St. Paul route. At the time the service began, the airline had sold \$125,000 worth of commuter tickets, according to Walter H. Johnson, senior vice president of marketing. American Airlines' first commuter tickets were scheduled to become effective last Saturday over the Boston-New York-Washington route. They will be paid for each in either direction. Each airline sells its commuter tickets in books of 10. Holders of the tickets book space by telephone and write flight number, date of departure and fare information—or, in Capital's case, a code number—on the flight coupon. They cash the transaction until the passenger manifests his coupon upon boarding his flight. Johnson and Capitalism, entered the commuter service to tie the New York market within the next 30 days. The airline plan was in line with Capital's intention "to make an transportation easier to use and more convenient to buy." American expects to evaluate the results of its commuter service at the end of October and then possibly apply it to other cities.

► **Continental Airlines** is providing free bus transportation between Chicago's Midway Airport and O'Hare Field for intra-air passengers connecting with the company's Boeing 707-120 flights between Chicago and Los Angeles.

► **Vickers-Armstrongs, Ltd.** says U. S. operators of Vickers Vanguard turboprop transport could bring in airline a potential profit of \$6.5 million annually per plane. The British manufacturer bases its profit picture on U. S. costs over 300-hour stage lengths, a beginning load factor of 48.8% by 1962 and attainment of an 86% load factor by 1968. Applied to European routes, Vickers says the Vanguard could turn a per-plane profit of more than \$19 million in the same seven-year period.

► **British European Airways'** net profits for fiscal 1963-64 dropped more than \$1.23 million from the previous year and totaled about \$444,000, according to a preliminary financial report by BEA chairman Lord Douglas of Brixton. Profits before paying interest charges on capital were about \$3.6 million. Passenger traffic for the last quarter of the current fiscal year, however, was up 22% above that for the same period of last year.

SHORTLENS

► **Ve Egyptien Desair** of the Red Sea Express Agency reports first scheduled flights during the first six months of 1959, 17,915 above that for the same period last year. Revenue for the period was up 20%—\$22,799,416 in comparison with \$18,956,734 for the last six months of 1958. Totals totaled 24,639,015, a 22% gain over the 1958 period.

► **Alghazay Airlines** carried 58,797 passengers over 16.7 million revenue passenger miles during July, a 27% increase for the latter six days of 1958. Air freight and express loadings totaled 417,000 lb., with air freight up 76% over July, 1958.

► **Martinez Coastal Airways** is now operating a Vickers Viscount V. 535 for ferry transport on its Victoria, New Brunswick, Goose Bay, Labrador, and Gander-St. John's, Newfoundland routes. The airline plans to use a conventional freight passenger configuration on the flight.

► **Mexicana Aereos (CMA)** is scheduled to begin Brazil Airlines non-stop service between Los Angeles and Mexico City on Sept. 1. The Brazilian will operate on Wednesdays, Saturdays and Sundays with CMA's Douglas DC-6s weekly operating on the other four days of the week.

► **Mohawk Airlines** carried 47,515 revenue passengers in July for a 30.2% increase over July, 1958. Load factor for the month was 93.1, a 0.5% increase over July, 1958.

► **Northeast Airlines** flew 165,315 domestic passengers 131,725,645 revenue passenger miles during July for 16.3% and 15.6% increases respectively over the same month of last year.

► **Seven Seas Airlines**, recently organized under authorization of the Federal Aviation Agency to operate contract air services on a world-wide basis, has purchased two Douglas DC-6 aircraft. The carrier, which was incorporated in Iowa, has offices in New York and Amsterdam. Seven Seas purchased the DC-6s from Twentieth Century Aircraft, Inc.

► **United Air Lines** has begun Chicago-Minneapolis daily round trip service using Convair aircraft. The carrier also has re-equipment Douglas DC-7s with through-service from both Philadelphia and Pittsburgh to Los Vegas, a weekly DC-7 service from Salt Lake City to San Francisco and daily DC-7 service from San Diego to Chicago.



SYMBOL OF A NEW SERVICE TO AVIATION

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Simulators Train Mercury Space Pilots

Re-Cross Levels

Langley Field, Va.—Micron capsule pilots will use a variety of simulators and simulation techniques to gain proficiency with the equipment that will use and because simulators with the conditions they will want while they make the first manned U.S. orbital flights through space.

National Aeronautics and Space Administration's Space Task Group will be putting the Vertigo pilots through a number of simulation systems and techniques here at Langley Research Center and elsewhere to familiarize them with the Mercury capsule and its operation. Pilots also will compare themselves with those space conditions which can be simulated on earth.

Basic Element

Simulator work is a basic element in the intensive training and indoctrination program the seven Mercury pilots began in April (AVF Mar 18, p. 10) to prepare them for the first U.S. landing of a man into orbit, probably in 1961. Mercury pilots are now moving into the initial stages of the simulator elements of the program.

Using standard computer revolution techniques, Space Task Group has de-

replaced a closed loop analog simulation of the Mercury mission, and thus the first system to be used in the training program. Each version of the simulator includes a three-instrument controller and radar/pulse, a configuration similar to the X-15 control system simulator. The Mercury system is isolated by range-control.

Pilot will be active as part of the closed loop system, and various displays and controllers will be tested during the program. Later screens will have a simulated crash at the time to be used in the Mission capsule and will be connected with a three axis controller.

This controller is based on its scaling capability and corrects any confusion eight cycles for the pilot. It can sense the velocity, for example, only at the

cyclic paths. Although the complete Maxwell mission cannot be automated, the orbital phase retrograde firing mode and so-on phase can be automated, and the pilot can be moved from one to another by some quick switching in the commander's station.

Since the urethra is a viable duct, an drainage system can be subrogated and work is confined to right control coordination and evaluation of control

systems and displays. There is no capability for introducing measurements

into the vortex. Many advanced civilizations, including some dynamic aspects of the Mercury mission, will be in convulsion during the seasons first month and next January in the Nazi's crucible at Jolietville, Pa. Coarsest nature crucible inmates will have the basic Mercury instrument panel with attitude rate attitude and acceleration instruments mounted. It will have the Mercury couch and the present season of the neutral harness, and it will also have the current production of the basic crucible.

McDonnell Aircraft Corp., the Minneapolis-based prime contractor, is responsible for the controller design. It will be a three-axis type, in which the pilot controls yaw through the position of his hand in moving the controller left or right, pitch through the wrist by moving the controller back or forward, and roll by bending his hand left or right around a pivot point three inches below his hand.

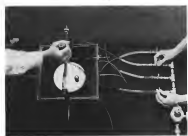
This fly-by-wire controller is a departure from the usual aircraft control system, and it has been suggested that the Mercury pilots might do better with one control in the pedals that are familiar with their steady operation. Space Task Group expects the pilots to accept the fly-by-wire controller as a separate system once they get some practice with it in the simulator.

Launch Application Button

In the contrary, the launch activation pattern will be run open loop since there will be no pilot control function during the actual Mercury launch. There will be no dynamic motion in

The attitude-manoeuvring simulation begins; there are no large accelerations involved. In this phase, the JPL attitude simulator will be a closed loop analog system much like the simulator at Langley. Centrifuge will be used in the x axis phase, and accelerations will depend to a limited degree upon pilot control, although there is not much change in acceleration vectors possible with the Mission signals discussed earlier.

Simulation at Jaramila will include some escape maneuvers and tactics following aborted missions. "Acrobatic" on the order of 20g, as the highest expected in the Mercury mission, but the pilot will not necessarily reach that level in training. Space Task Group wants to avoid stresses of entering the pilot, and the higher acrobatic will be used only if the



BALL BEK space-lignt control simulates parabolic Mewers plate with parabolic, in-swing control surface with no damping and no swing response. Pilot grips handle and maneuvers the disk to keep the lively rolling ball centered on it. Air plot can be used to show the ball across the disk to simulate motion when asterooids are fired on the Mewers capsule. Keystones required to keep the ball centered on the disk are visible; to these used to keep the ball under control in the Mewers capsule.



C-119 Recovers Discoverer Payload in Test

Parade of General Electric polylid for the ARPA/Lockheed WS-119L. Deconvolver satellite is stored in a cable trailing basket in Fairchild C-119 during practice tests of an recovery of the suit after it has been ejected from orbit. In tests, the polylid is dropped from another aircraft. In the picture at right, weak system calls the console into the C-119's bay.

definitely has training value, according to Harold Johnson, chief of the training device section of STG's Operations Division. Some acceleration factors will be used to check out the hardware with the Mercury pilots.

The training exercises in the early simulation here at Langley are largely for engineering evaluation of the system, the controller and the display. The work at Johnson's will have this function, but it also will provide the pilots more realistic familiarization with the Mexican situation. The January session at Johnson's will be generally the same as the August program, except it will be somewhat more sophisticated, probably with more complexity, for more

Post-Loading Trials

Therapy and recovery from a fall don't end with conditions; the pilots will maintain their training. It will cover the use of recovery equipment, getting out of the capsule in various air conditions and surviving and using the suit. The trainer will have all the relevant equipment the pilot must contend with in leaving the capsule, and it will have the

Thinning will take place with the escape and removal simulators in the winter. It will be done whenever the necessary wet states can be found, including remaining pools, rivers, Chesapeake Bay and the Atlantic Ocean. Thinning can be coordinated with a harvest of the *Neos cyprinoides* stock.

An aerial capsule will be gradually lowered in the altitude and turned at

Levin Research Center for fixing of introduced and clearance of the in active control system. There, the plots will become familiar with the trend of the introduced fixing and will become accustomed to using the hydrogen peroxide in control system.

Participation with the neighborhood conditions of aerial flight will be conducted with zero-gravity aircraft flights. Some of the pilots made such flights each in the program in a specially equipped Cessna C-431, and some of these flights are planned. Space Task Group wants to determine the possible effects of recolonization following a zero-gravity condition. Some efforts were noted in week done at Wright Air Development Center, but they were not enough to serve.

Zero-gravity flights of longer duration than is provided by the C-17 may be arranged, and STG is studying the use of the Lockheed F-10HB for this purpose. Pilots also may fly the Bell X-14 as X-15 during the training program, but no final decision has been made. They will not fly the North American X-15.

Merrow's pillow was not a water tank, nor gravity ventilation developed here at Loughborough, although this will be questionable until the tank system has been tested. With this ventilator, a mass is put in water which he cannot see and is decorated. This furnishes a low resolution of zero gravity.

Full drill, space, flight control was later developed here and provided paratroopers with control without the damping and no spring response. The pilot grips a handle with a drill, and

THE NAVY'S POLARIS:

DONNER *helps it think...*

One day soon the U. S. Navy will fly a report more fantastic than any you've ever heard. That will be the launching of the Navy's spectacular Polaris missile from a submerged nuclear submarine. Advanced testing is underway, the Polaris will be ready for the first in 1960.

Smaller and lighter than other intermediate range ballistic missiles, this formidable Lockheed developed weapon features much that is new in advanced electronics. It even "thinks" for itself.

One such "think" device aboard the Polaris is a system developed by Donner Scientific Company using as a base a standard Model 4310 Accelerometer. The system monitors flight performance like a policeman directing traffic. If, for example, in the initial portion of the flight, the missile does not achieve sufficient velocity by a pre-determined time, the Donner system aborts the flight. The missile gets the go-ahead only as programmed.

Donner's role in the Polaris project represents another huge contribution from an engineering team which specializes in accurate systems, microlocking time, acceleration, velocity and other reports designed to meet customers' requirements.

Donner welcomes your inquiry concerning the company's capabilities in this and related fields. Write: Donner Scientific Company, Concord, California.

DONNER SCIENTIFIC COMPANY
Concord, California



Satellite Radar Must Be Ultra-Reliable

By Philip J. Klein

Washington—Development of a lightweight, ultra-reliable weather radar requested by National Aeronautics and Space Administration for use in a meteorological satellite represents a major challenge to the ingenuity of the nation's radar designers.

With a radar-equipped meteorological satellite, NASA scientists hope to obtain a three-dimensional picture of precipitation around the earth, enabling meteorologists to detect severe weather in their development and to avert the earth's heat balance.

Design Requirements

Here are a few of the challenging requirements outlined in the specification which NASA sent to industry:

- **Reliability:** Radar must be able to operate continuously and reliably for a minimum of six months, possibly for a full year. Some simple adjustments for improving performance are possible by means of remote radio control.

- **Coverage:** Meteorological satellite will be stationed so that one axis remains perpendicular to the earth's surface, with no rotation about this axis. NASA would like a scanning radar which can provide full coverage of all of the earth that can be viewed from the satellite but will settle for a strip a few hundred miles wide beneath the satellite if the former is not feasible.

- **Range:** First models of the radar will operate from a satellite at an altitude of about 500 mi., but the ultimate design must be suitable for orbits at altitudes of 500 to 1,500 mi.

- **Resolution:** NASA seeks a resolution equivalent to about 5 mi. on the earth's surface. This corresponds to a beam width of about one degree for a satellite at 500 mi. altitude. To establish height of precipitation above the earth, NASA seeks a range resolution of about 1,000 ft.

- **Electric power:** First models will be powered by solar cells and storage batteries capable of supplying only 50 to 100 w. average power, NASA says. Ultimately, the power available to the meteorological satellite is expected to be one to five kilowatts. (By way of comparison, existing airline weather radars with a maximum range of about 150 mi. require 750 to 1,000 w. power.)

- **Sensitivity:** If possible, radar should be capable of detecting precipitation falling at the rate of 0.1 in. per hour corresponding to a radar reflectivity of 0.000005 in. meters per cubic meter. Radar receiver should have a logarithmic response to a factor of 10-

erred signal strength. Receiver output should be in decibel steps with 5 to 10 levels.

- **Autonomy:** Because physical maintenance of the radar systems to achieve scanning would produce torques that would disturb satellite stabilization, NASA suggests the use of slot type antennas and electronic scanning techniques.

Requesting Proposals

NASA is asking industry for proposals on both a feasibility study of the satellite weather radar and on a second phase that would include fabrication of a working laboratory model. Feasibility study is to be completed by Jan. 1961, and should indicate how to carry model

can be developed into a more sophisticated climate system for use in an operational satellite. NASA is asking that the laboratory model be available by spring of 1961.

Unclassified Techniques

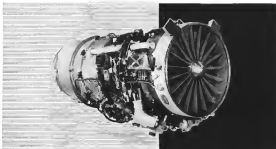
Insofar as possible, the techniques employed in the satellite radar are to be unclassified, NASA says. If it proves necessary to use classified techniques, NASA says it will arrange for the use of such information for the contractor and will request the classification of these parts of the work.

NASA suggests the use of X-band (3.2 cm.) for the satellite radar in preference to lower frequencies because of the problems of obtaining accurate mea-



Scientists Study Entry into Venus' Atmosphere

Most now shown is placed at end of 40-ft. shock tube in Lockheed Martin and Space Donner's Scientific Research Laboratory in a study of the problem of entry into the atmosphere of Venus. Studies by scientists K. K. Chou (left) and Richard W. Fetter (right) show problems in 1957 probe for Venus that it would be for a return to earth.



DEVELOPED FROM EXPERIENCE

The Rolls-Royce Conway by-pass turbo jet is in production for the Handley Page Victor B Mk.2, the Boeing 707-420 and the Douglas DC-8, and will power the Vickers VC 10.

The by-pass or ducted fan principle which Rolls-Royce have proved in the Conway is now accepted as the correct formula for all jet transport and for certain military applications. The new RB.141 family of by-pass jet engines is based on 7 years' development experience of the by-pass principle and on 6 years operation of other gas turbines in airline service. The first of this series of engines has already been chosen to power the new British European Airways medium range jet aircraft.

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latter with accuracy, too, without Moscow it does not rule out the use of other frequencies.

In the ultimate operational reconnaissance satellite, a tremendous amount of radar data will be collected. Present plans are to store the data aboard the satellite on a tape recorder, then transmit it down when the satellite passes over a ground radio station.

The contractor selected to study and develop the satellite will also need to concern himself with the design of the data storage, communications and power power source, except as the latter affects the radar design, according to NASA.

Companies that would like to bid on the satellite weather radar program may obtain copies of the specifications and other details by contacting: Director of Procurement and Supply Division, NASA, 1515 H St. N. W., Washington D. C.

Soviets Measure Geomagnetic Field

Moscow—Soviet Union has disclosed some of the results of its satellite and rocket program to ascertain the geomagnetic Cassini Res. Conference, here. A report on the results of Soviet space research that was delivered last March to the USSR Academy of Sciences in its president, Aleksandr Novosadov, has been published in seminars, in recent Soviet newspapers.

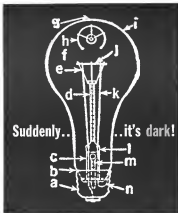
The report states that Soviet research has established that near earth space contains 15 geomagnetic belts, located from 25 to 1,000 km, with atomic energy constituting the basic ground component from a height of 15 km to at least 500 km. Some research now also has been detected as well as belts, particles with molecular weights of 70 and 10. Novosadov said.

With further investigation (the discussion) can be undertaken in solving the ionosphere problem of the upper atmosphere," he said. The report stated that atomic energies involved in relation to atomic energy energy from 15° to 185° depending on height and geomagnetic latitude and varies with type of time. "Differs dependence of discovered components of the ionosphere on geographic latitude has been determined," the report continued.

Novosadov said "extremely important results were obtained in measurement of the geomagnetic field with the help of Soviet space rockets."

"It has been established," he said, "that the difference between theoretical and actual value becomes appreciable at a distance of approximately two thousand miles from the center of the earth and then increases sharply."

Variations in the magnetic field



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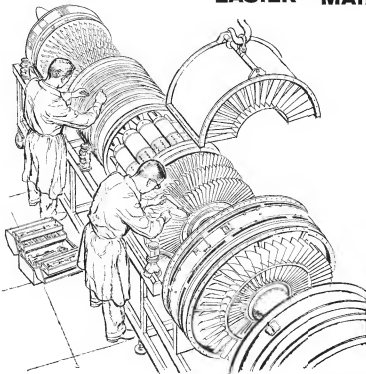
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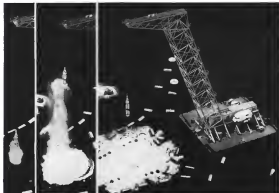
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Crane, Hydraulic Ram Retrieves Polaris Dummy In San Clemente Tests

Lockheed Missile and Space Division and Westinghouse Electric have developed Operation Polaris to retrieve damaged Polaris missile stages after firing from an underwater launching tube. Missile is reeled in by cable operated from the 110 ft. high crane, hydraulic ram-type piston looking is used to keep the Polaris from falling back into the sea. Polaris is an operation of San Clemente Island as range of U.S. Naval Ordnance Test Station, China Lake, Calif. Earlier mission method involved use of modified crane slings, setting gear (AW May 25, p. 68).



Honeywell puts man in space —at zero altitude

**Advanced space environment simulator will isolate
two men in Honeywell-controlled space flight
environment during unprecedented 30-day test**

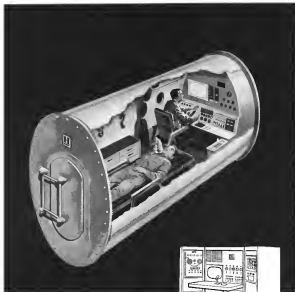
As another step toward man's conquest of space, Honeywell will provide the USAF School of Aviation Medicine with an environment simulator for use in researching human reaction to isolation in space. The test capsule developed by Honeywell will hold two men and all the life-sustaining materials they need for 30 days. It provides a completely self-sufficient environment contained in a 12- x 6- x 5-foot package. When man travels space, the air he breathes, the food he eats, temperature control, waste disposal, and all other basic elements must be precisely planned and controlled. This poses serious problems involving toxic gas, radiation, oxygen, lighting, and many others. In solving these, Honeywell utilizes advanced engineering techniques developed during more than 70 years of leadership in environmental control.

Honeywell Capability

Human environment, however, is only one of many fields in which Honeywell can demonstrate space flight capability. For example, *Guidance and Stabilization*. Honeywell's reference system

is a remarkably accurate series of missile guidance and control proved in actual applications, *Pilot Control*. Honeywell has more experience in the field of flight control than any other company. Proved systems include autopilots, reaction controls, jet-vane controls, thrust vector controls and automatic landing systems. *Data Processing*. Honeywell capability includes sensing, recording, maintaining, and interpreting *Ground Monitoring*. Some of the most extensive and complex work done by Honeywell in the missile field concerns the development and operation of test and checkout equipment. This work includes depot overhaul and maintenance equipment, base level overhaul and maintenance equipment, and launch site checkout equipment. Additional Honeywell expertise includes environments, auxiliary airborne power systems and research into human factors, both biochemical and psychological.

If you have a problem in the design of systems or components in the field of space flight, call or write Honeywell, Military Products Group, 2755 Fourth Ave., South, Minneapolis 8, Minnesota.



Two-man hermetically-sealed space cabin simulator. The basic chamber of the simulator will contain equipment that would be found in actual space flight. Oxygen, carbon dioxide, toxic gases, temperature and humidity are continuously and individually sealed and compared to a set value. When safety limits are exceeded an error signal is amplified and corrective action is automatically begun. A sufficient water supply and facilities to insure personal cleanliness will be provided. Ample storage facilities for a consumable foodstuff will be provided for the 30-day isolation.

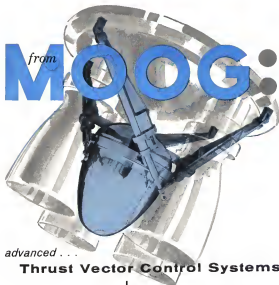


Driver controls, lights, pressure and temperature monitoring, communications display, the capsule. Personnel inside will be kept by radio monitoring, TV cameras, and control display units.

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TUNNEL DIODE transistor (left) consists of one variable and two fixed energy separation, being, and the tunnel diode located under the one. Close-up of a tunnel diode (right) shows the connecting wire leading into an alloy dot which is soldered to a germanium crystal diode (center) which is then soldered to a rectangular metal plate that forms the other connection.

Tunnel Diodes May Cut Transistor Costs

By James A. Fucci

New York—Semiconductor scientists are becoming increasingly interested in the promising new device called the tunnel diode. Latest results to be announced are those of scientists at the General Electric Research Laboratories where tunnel diodes have been incorporated in operating experimental circuits such as an FM transmitter, an FM receiver, and in automatic and manual controlled oscillators.

Sample Quantities

Characteristics of the tunnel diode that have attracted interest include the ability to operate at frequencies as high as 10 kilocycles per second, power output as low as one milliwatt at a watt, and an exceptionally small figure of about one cubic millimeter.

General Electric says that it will be offering tunnel diodes in sample quantities in late September at an approximate price of \$75 per diode. Eventually, the company hopes to make available a complete line of different types of tunnel diodes at prices below the cost of the various types of transistor available commercially today.

Tunnel Diode

The tunnel diode takes its name from the quantum mechanical tunneling phenomenon in which electrons stream more through the device at the speed of light. They high speed makes possible operation at extremely high

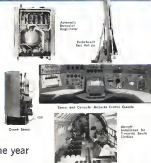
frequencies. Oscillators employing tunnel diodes have been developed successfully at frequencies above 2,000 mc, and General Electric says that it expects to obtain operating frequencies above 10,000 mc in the near future. Several advantages are claimed for the tunnel diode in comparison with transistors. The tunnel diode is smaller than a conventional transistor and, because of its unique structure, vibrational stability is believed to be a function of its present size. It is relatively immune to conventional radio noise. Since tunnel diodes made by General Electric have been operated at temperatures to 500° F., manufacturers indicate that the device is 1,000 times better at resisting

the actual effects of nuclear radiation. One of the most interesting characteristics of the tunnel diode is that it is a negative resistance device. First reported by Dr. Leo Esaki of Japanese Sony Corp. in early 1958, the device has attracted wide attention in this country. Other research facilities known to be actively investigating tunnel diodes are RCA Laboratories, Bell Telephone Laboratories, and Air Force Cambridge Research Center. Several different materials are being studied, including silicon, germanium, gallium arsenide, gallium antimonide, cadmium antimonide, and silicon carbide.

In quantum mechanical tunneling, an electron, in a hole, disappears from one

Comparison of Tunnel Diode Characteristics

	Maximum Frequency of Operation (in mc.)	Minimum Power Requirements (mW)	Low Noise Amplification (Noise Temperature at 1,000 mc.)
Tunnel Diode	5-10	0.00001	100-2000
Transistor	5	0.001	1,000
Vacuum Triode	10	0.1	1000
Parametric Amplifier	4	10	1000 (Cold input temp.)
Tunneling Noise Filter	40	10	2000
Mixer	10	100	1000



AN/AMQ-15

... concept to reality in one year

Just one year ago, the Air Force Global Weather Reconnaissance Program was only a system concept. Today, the feasibility of this advanced airborne system has been demonstrated at realistic speeds and altitudes.

The Bendix AN/AMQ-15 system includes advanced airframe sensors for measuring thin-film geophysical parameters along the flight path, and advanced dropsonde and rocketsonde sensors for measuring eight parameters in a vertical profile from sea level to 150,000 feet. Other subsystems are storm radar, cloud top and base radar, air sampling, airborne digital data processing and display, and ground data handling.

For flight demonstrations up to altitudes of 45,000 feet, the Bendix Airplane Company has installed AN/AMQ-15 subsystems in their prototype T37 jet

transport. In addition, Bendix has completed design of cockpit test vehicles at Bendix Air Force Base. In reporting this achievement of a major system design and implementation, Bendix is very proud of the contribution of its own divisions, and is most appreciative of the cooperative teamwork provided by the Air Force, Boeing, and other subcontractors. The result is a flexible and modular system which can be used in various sized packages for all types of aircraft ranging from strategic bombers to interceptors, and for civilian transport aircraft.

The AN/AMQ-15 is typical of the hard-killing programs being carried out by Bendix Systems. Better engineers and scientists interested in pioneering systems of the future are invited to join this growing team.

Bendix Systems Division

AN AIR FORCE COMPANY



TUNNEL DIODE, shown in use at bottom, is capable of the fastest recovery time in FM receiver applications, multistage, cross-screen beamforming detectors and automatic frequency control. An FM receiver built using a tunnel diode, the conventional cross-pole antenna, at the top could be mounted, with some sacrifice in performance.

with a potential barrier and exhibits negative resistance on the other side although it does not have enough energy to overcome the barrier. In the case of the tunnel diode, the barrier is the space charge depletion region of a p-n junction. This is the same barrier which prevents current from flowing in the reverse direction in an ordinary rectifier diode.

This barrier is made transparent when the tunnel diode is on the other side of the barrier so that penetration by the tunnel effect is possible.

This gives rise to an additional current in the diode at very low forward bias which disappears when the bias is removed.

It is this additional current that produces the negative resistance in the device.

Free Carriers

The origin of this additional current can be explained by considering the changes in the characteristics of a conventional p-n junction diode at higher concentrations of free carriers are added in a semiconductor crystal.

As the density of charge carriers is increased, the reverse resistance is lowered, and the forward resistance is increased.

This reverse resistance is called, however, does not reach a limit at zero. The lower limit is determined by the inhibition of the separation which determines the carrier concentrations. Experiments have shown that once semiconductor materials can be doped heavily enough so that the diode can still be in the reverse breakdown condition at a small forward bias.

When a larger forward bias is applied, the diode goes out of the reverse breakdown condition and the current falls to a small level. The reverse breakdown current that flows with a forward applied bias establishes the negative resistance of the device.

Diode Advantages

In competition with conventional tubes, transistors and other electronic devices, General Electric believes tunnel diodes have the following advantages:

- For communication applications, tunnel diodes compete with transistors, parametric amplifiers, vacuum tubes, magnetrons and klystrons, having some tubes and magnetrons. Tunnel diode characteristics are compared at their high oscillation frequency, microwave power requirements, and low loss noise amplification (noise figure of about one decibel).

- In computer applications, tunnel diodes will compete with transistors. The diode is at least 100 times faster than present diode transistors, according to General Electric, and can be made to operate at only about 100 mV of the power. Tunnel diodes also are reliable, maintain temperature changes which may permit simplification without sacrificing stability.



Electrostatic Gyro

Highly accurate electrostatic gyro whose spacing ratio is supported in a vacuum by electric fields instead of by conventional bearings is shown here. Electrostatic drift gyro, developed by Minneapolis-Honeywell, will soon replace rotor mode of best inertial and nonbearing by inertial of 10/100th inch. However, before the gyroscopic mode, Navy Bureau of Ordnance sponsoring, and research needed RAN contract to study airborne application. Also this step gyro is a step to accurate inertial navigation, General Electric also is developing electrostatic gyro suspension.

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powerful radio telescope being assembled on the 100,000-superdust floor of the Canyon plant, one of our fine plants in the U.S. In a word, Bliss has the facilities and skills to be any job involving metal manufacturing from plan to finished product.

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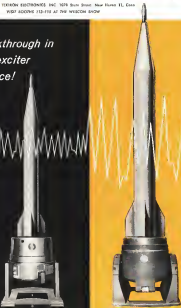
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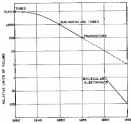
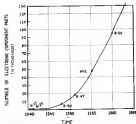
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GROWING COMPLEXITY of systems equipment needed to launch aircraft is shown at left in terms of the approximate number of components, such as printed-circuit modules of equipment (solid). Microelectronic gains achieved in the last two decades through the use of smaller components, tubes and transistors, are compared at right with the results expected from the Air Force's new molelectronics program.

USAF Investigates Basic Molelectronics

Durham—During the past decade, Air Force weapon systems have become increasingly complex in order to accomplish their increasingly difficult mission assignments. One vivid example is in the number of electronic components required. Whereas the Boeing B-71 and B-727 use about 20,000 components each, a single thousand components the B-47 has an estimated 20,000 and the B-52 approximately 50,000. The total for the Douglas B-85 is around 90,000 and the North American B-73 will show a corresponding increase.

Design Problems Created
This trend has created a number of major problems for the air-space vehicle designers, including size, weight and electronic power requirements. Perhaps the most critical is the linear relationship which results from the increase in the number of components that the reliability of a system is equal to the product of the reliabilities of each of its individual components. In addition to the complexity themselves, these results are two solidified corner stones for every component—such as an other potential cause of failure.

The electronics industry has not been standing still during the last few years. It has surpassed the performance of components and has made significant advances in their size. However, the curve reveals that the reduction in size has been approximately a straight-line function for the past several years. This is not adequate to meet the greatly increased complexity of weapon systems and the demands for small size, weight and power of air and space vehicles.

Furthermore, it appears that a continuation of this evolution change cannot meet our needs. We need a new concept, or breakthrough in the electronic components field.

Several years ago this situation was discussed with a number of major contractors from industry and contracts were placed with hopes that breakthroughs would be achieved.

From a contractual standpoint, these programs were relatively successful, but we learned that size cannot contract for a breakthrough.

At first, we were thinking of functional components which were designed as single items that could replace a tube or transistor and as far as supporting power components. These functional components were to amplify, switch, oscillate or perform one of the usual other functions usually found in a single component. We were very so cautious in the thinking of a complex, communications or radar receiver that could be as simple as to have input, output and power leads only, with the search being a solid material instead of an assembly of hundreds of components. The term "molelectronics" was coined.

It has been said by the Air Force to describe this technology for which we were searching. Molelectronics has been defined as the reduction of size for both performance and electronic program area so that under a particular threshold, the matter exhibits complex and complete electronic functions that previously were performed by distinct combinations of active and passive components.

A molelectronics device that performs such a function has been named a "functional electronic block," or FEB (pronounced "Ferb") for short. A FEB might, for instance, be a band-pass amplifier having a gain of 40 db at 955 mc with a 10 kc bandwidth and an output of 100 milliwatts.

Research Program
Because the previous contract of FEB was not completely successful, it was felt that the next best thing would be to create a research program where input would be an environmental environment to revolutionary advancements in electronic technology.

To accelerate a scientific revolution in the field through application of molelectronics required new knowledge and tools which could only be obtained through advance and collaborative research programs. The source of the molelectronics approach is highly dependent upon the revolution of basic information needed as the backbone of atomic, molecular and crystal of matter, and on the development and application of new and novel concepts and approaches to the design of micro systems. Full advantage had to be taken of